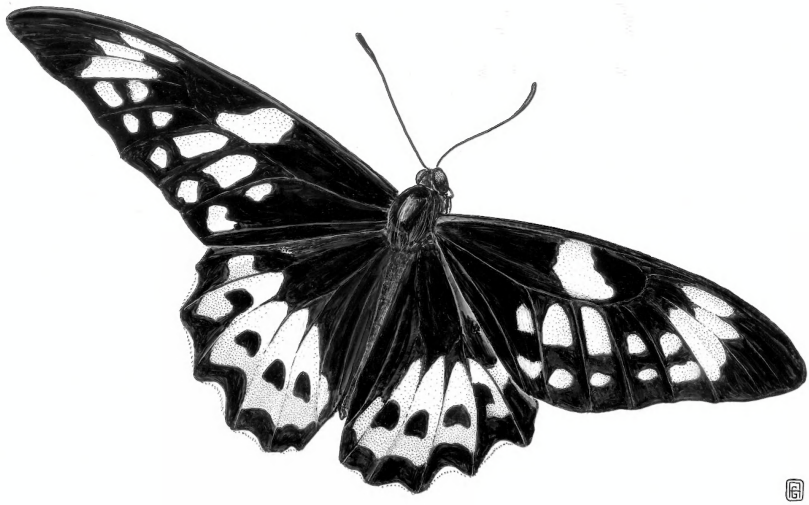
THE AUSTRALIAN Entomologist

published by
THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND



Volume 46, Part 3, 20 September 2019

Price: $8.00 per part

ISSN 1320 6133

THE AUSTRALIAN
Entomologist

Volume 46, Part 3, 20 September 2019

BEAVER, E. P.
A new species of *Aenetus* Herrich-Schäffer (Lepidoptera: Hepialidae) from Tasmania, with notes on the *splendens* group of species in South Australia 125

BRABY, M. F.
First record of *Neohesperilla xiphiphora* (Lower, 1911) (Lepidoptera: Hesperiidae) from Western Australia 105

HUTCHINSON, P. M. and ALLSOPP, P.G.
Bolboleaus houstoni Howden, 1985 (Scarabaeoidea: Geotrupidae: Bolboceratinae): diagnosis of the female, placement in a key and notes on distribution and habitat 119

JOHNSON, I. R. and WILSON, P.R.
New Australian records for subspecies of Nymphalidae and Lycaenidae (Lepidoptera) from Dauan Island, Torres Strait, Queensland 113

LAMBKIN, T. A.
First record of *Yoma algina netonia* Fruhstorfer, 1912 (Lepidoptera: Nymphalidae: Nymphalinae) from Torres Strait, Queensland, Australia 107

LAMBKIN, T. A.
A further record of *Charaxes marki* Lane & Müller, 2006 (Lepidoptera: Nymphalidae: Charaxinae) from Timor Leste 110

MACKEY, A.P
A new combination for the New Guinean moth *Euproctis virginea* Bethune-Baker, 1904 (Lepidoptera: Erebidae: Lymantriinae) 139

THEISCHINGER, [redacted]
Austrophya monteithorum sp. nov., a new dragonfly (Odonata: Anisoptera, Libelluloidea) from tropical Queensland, Australia, with notes on its collection and locality 145

BOOK REVIEWS
Helen Lunn and Marcus Byrne. *Dance of the dung beetles* 156

M.F. Braby, D.C. Franklin, D.E. Bisa, M.R. Williams, A.A.E. Williams, C.L. Bishop and R.A.M. Coppen. *Atlas of butterflies and diurnal moths in the monsoon tropics of northern Australia* 157

RECENT LITERATURE 159

[redacted]

FIRST RECORD OF *NEOHESPERILLA XIPHIPHORA* (LOWER, 1911) (LEPIDOPTERA: HESPERIIDAE) FROM WESTERN AUSTRALIA

MICHAEL F. BRABY

Division of Ecology and Evolution, Research School of Biology, Australian National University, Acton, ACT 2601; and Australian National Insect Collection, GPO Box 1700, Canberra, ACT 2601

Abstract

Neohesperilla xiphiphora (Lower, 1911) is recorded from Western Australia for the first time in the northern Kimberley. A male was collected from the mainland east of Middle Osborne Island in February 2019, extending the known geographic range approximately 500 km west of the 'Top End' (Daly River, NT). This new location, together with previous records from the Top End and northeastern Queensland, suggests the species is distributed widely throughout the monsoon tropics of northern Australia.

The trapezitine skipper *Neohesperilla xiphiphora* (Lower, 1911) is endemic to northern Australia and has a disjunct distribution, occurring in the north of the Northern Territory and in northeastern Queensland (Braby 2000, Braby *et al.* 2018). In the Northern Territory it occurs widely in the 'Top End' (*sensu* Braby *et al*. 2018) and western Gulf Country, where it reaches its southwestern limit at Daly River (Waterhouse and Lyell 1914) and southeastern limit at Caranbirini Creek (Dunn and Dunn 1991), NT. In the Top End, *N. xiphiphora* has been recorded breeding in savanna and eucalypt woodlands in the higher rainfall areas (> 1,000 mm mean annual rainfall), particularly along the edges or bases of rocky outcrops where the larval food plant, *Sorghum intrans* F.Muell. ex Benth. (Poaceae), grows as an annual grass in the open shaded understorey beneath eucalypt trees (Braby 2015). The butterfly has not previously been recorded from the Kimberley in northern Western Australia, although the larval food plant has been recorded from this region at King Anna in the southern end of Vansittart Bay, WA (14.24194°S, 126.26694°E) (AVH 2019).

A single male *N. xiphiphora* was collected from the northern Kimberley mainland east of Middle Osborne Island, WA (14.32935°S, 126.07322°E) in mixed coastal paperbark swampland and monsoon vine thicket on 18 February 2019. Comparison of the specimen with material from the Top End indicates that the upper and underside ground colour is deeper orange and the two cream central spots on the hind wing are enlarged, but otherwise it is identical to *N. xiphiphora*. The specimen is deposited in the Australian National Insect Collection, Canberra.

The location extends the known range of *N. xiphiphora* by approximately 500 km W of Daly River, NT and represents the first record of this species in Western Australia. The site is located 23 km SW of the *S. intrans* record noted above. Interestingly, the new record of *N. xiphiphora* from Western

Australia adds to the growing number of new records of butterfly and day-flying moth species from the Kimberley. A further 11 species of butterflies (*Hasora chromus chromus* (Cramer, 1780), *Neohesperilla senta* (Miskin, 1891), *N. crocea* (Miskin, 1889), *Taractrocera dolon diomedes* Waterhouse, 1933, *T. psammopetra* Braby, 2015, *Eurema alitha* (C. & R. Felder, 1862), *Acraea terpsicore* (Linnaeus, 1758), *Nesolycaena caesia* d'Apice & Miller, 1992, *Petrelaea tombugensis* (Röber, 1886), *Theclinesthes sulpitius* (Miskin, 1890) and *Everes lacturnus australis* Couchman, 1962) and seven species of day-flying moths (*Synemon* sp. 'Kimberley', *Hestiochora xanthocoma* Meyrick, 1886, *Birthana cleis* (R. Felder & Rogenhofer, 1875), *Leucogonia cosmopis* (Lower, 1897), *Radinocera* sp. 'Sandstone', *Mimeusemia econia* Hampson, 1900 and *Comocrus behri* (Angas, 1847)) have been newly recorded from the Kimberley in recent decades (*i.e.* since 1990) (Braby *et al.* 2018). In fact, 13 (72%) of these 18 species have been detected within just the past five years (since 2014). Such an extensive list underscores the biogeographic importance of the region (Braby 2008) and suggests the inventory for the northern Kimberley is incomplete. Further surveys and sampling are therefore likely to uncover additional species of diurnal Lepidoptera.

References

AVH (AUSTRALIAN VIRTUAL HERBARIUM). 2019. [Accessed 23 May 2019]. *https://avh.ala.org.au/occurrences/search?taxa=Sorghum%20intrans#tab_mapView*

BRABY, M.F. 2000. *Butterflies of Australia. Their identification, biology and distribution*. CSIRO Publishing, Collingwood, Melbourne; xx + 976 pp.

BRABY, M.F. 2008. Biogeography of butterflies in the Australian monsoon tropics. *Australian Journal of Zoology* **56**: 41-56.

BRABY, M.F. 2015. New larval food plant associations for some butterflies and diurnal moths (Lepidoptera) from the Northern Territory and Kimberley, Australia. Part II. *Records of the Western Australian Museum* **30**: 73-97.

BRABY, M.F., FRANKLIN, D.C., BISA, D.E., WILLIAMS, M.R., WILLIAMS, A.A.E., BISHOP, C.L. and COPPEN, R.A.M. 2018. *Atlas of butterflies and diurnal moths in the monsoon tropics of Northern Australia*. ANU Press, Canberra; xxxii + 430 pp.

DUNN, K.L. and DUNN, L.E. 1991. *Review of Australian butterflies: distribution, life history and taxonomy. Parts 1-4*. Published by the authors, Melbourne; 660 pp.

WATERHOUSE, G.A. and LYELL, G. 1914. *The butterflies of Australia. A monograph of the Australian Rhopalocera.* Angus and Robertson, Sydney; vi + 239 pp.

FIRST RECORD OF *YOMA ALGINA NETONIA* FRUHSTORFER, 1912 (LEPIDOPTERA: NYMPHALIDAE: NYMPHALINAE) FROM TORRES STRAIT, QUEENSLAND, AUSTRALIA

TREVOR A. LAMBKIN

School of Biological Sciences, University of Queensland, St Lucia, Qld 4072
(*Email: trevor.lambkin@uqconnect.edu.au; t.lambkin@hotmail.com*)

Abstract

The first specimen of *Yoma algina netonia* Fruhstorfer, 1912 recorded from Torres Strait (on Dauan Island) is discussed and illustrated.

Introduction

The genus *Yoma* Doherty, [1886] was considered until recently to be monotypic (Braby 2000, Lambkin and Kendall 2016), containing only *Y. sabina* (Cramer, [1780]). However, Lambkin and Kendall (2016) determined, using several adult and immature character states, that the genus contained a second species, *Y. algina* (Boisduval, 1832), which occurs predominantly in the New Guinea region from Waigeo Island through to the Solomon Archipelago and Vanuatu (Parsons 1998, Tennent 2002), with *Y. a. netonia* Fruhstorfer, 1912 occurring in southern Papua New Guinea, particularly at Port Moresby (Parsons 1998). Lambkin and Kendall (2016) confirmed that *Y. algina* also occurs in northern Queensland, in Cape York Peninsula from Somerset at Cape York to Peach Creek, 25 km NNE of Coen. The Queensland population was assigned tentatively to *Y. a. netonia*.

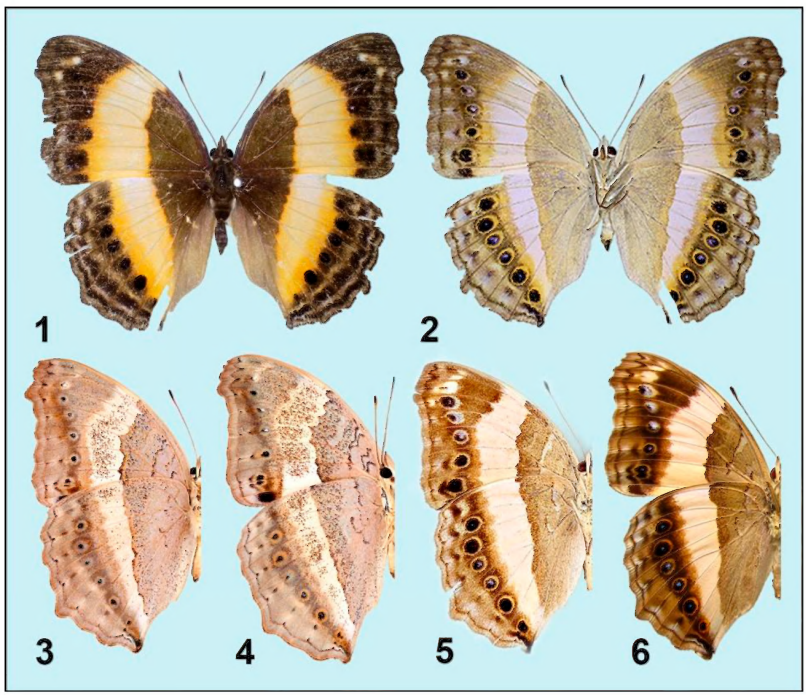
Larvae of *Y. algina* are currently known to feed only on *Hemigraphis* spp (Acanthaceae), with *H. ciliata* S. Moore a likely host on Cape York Peninsula (Lambkin and Kendall 2016). Although *Y. sabina* is known from several Torres Strait islands (Braby 2000, Lambkin and Kendall 2016), *Y. algina* was previously unrecorded from the Strait. However, a single female was collected in 2018 by the author on Dauan Island and constitutes the first record of *Y. algina* from Torres Strait. This specimen is documented and illustrated here, together with field observations and a discussion of the species' possible distribution in Torres Strait.

Abbreviations: HUC – Harvard University, Cambridge, MA, USA; MV – Museum of Victoria, Melbourne; QM – Queensland Museum, Brisbane; TLIKC – Joint collection of T.A. Lambkin and A.I. Knight, Brisbane; Names on labels: GAW – G.A. Waterhouse; GBM – G.B. Monteith; RGE – R.G. Eastwood; TAL – T.A. Lambkin.

Field observations and discussion

In January 2018, on Dauan Island, a female *Y. algina* (Figs 1-2) was collected on the edge of the village (at sea level) facing Mt Cornwallis. It flew in a spiralling manner approximately 1 m above the ground in an open grassed area about 5 m from the edge of monsoon vine forest. Interestingly, its mode

of flight was unlike that of female *Y. s. sabina*, which typically flies in a jerky manner, often interspersed with short periods of gliding. Parsons (1998) discussed both *Yoma* species occurring in the Port Moresby area but did not describe their flight behaviour and whether the observed manner of flight of the female *Y. algina* from Dauan Island is consistently different from that of *Y. s. sabina* remains to be seen.



Figs 1-6. *Yoma algina* from Queensland (all figures to scale), (1) upperside, (2-6) underside. (1-2) ♀, Dauan I., Torres Strait, 15.i.2018, TAL (TLIKC) [forewing length 39 mm]; (3) ♀, Lockerbie area, Cape York Peninsula, 13-27.iv.1973, GBM (QM) [39 mm]; (4) ♀, Iron Range, Cape York Peninsula, 1-9.vi.1971, GBM (QM) [40 mm]; (5) ♂, Somerset, Cape York Peninsula, Lep 11424, 10.iv.1906, 'doubtfully Australian, GAW' (MV) [39 mm]; (6) ♂, Philip Hill, Iron Range, 10.i.1994 RGE (HUC) [40 mm].

Yoma s. sabina also occurs on Dauan Island and can be relatively common there at times during the wet season (December to April). Females are most often observed lurking deep within the forest understory searching for host plants and are not often observed flying in open areas, whereas males often patrol forest edges, alighting on sunlit foliage (Lambkin and Kendall 2016).

Lambkin and Kendall (2016) indicated that *Y. algina* is likely restricted to wet forest areas or rainforest where *Hemigraphis* spp occur. In Torres Strait, true rainforest tends to be restricted to some of the taller peaks such as Mt Augustus (elevation 240 m) and Banks Peak (370 m) on Moa Island and Mt Cornwallis (295 m) on Dauan Island. However, in their floral surveys of Torres Strait, Stanton *et al.* (2008) and the Torres Strait Regional Authority (2013) did not list *Hemigraphis* from any island and the Atlas of Living Australia (2019) has no records of *Hemigraphis* spp naturally occurring in Torres Strait. Thus the specimen of *Y. algina* collected on Dauan Island might be a vagrant from southern Papua New Guinea. Alternatively, if the species is breeding on Dauan Island it could be restricted to the upper reaches of Mt Cornwallis, where the flora is still not well documented (Stanton *et al.* 2008), or is utilising other host plants.

The underside facies of the Dauan Island specimen lies within the range of variation of *Y. a. netonia* from Cape York Peninsula (Figs 3-6) and it is therefore tentatively included in that subspecies.

Acknowledgements

I thank the local community councils and island elders of Dauan Island for allowing entry into their community and assisting during the collection of material. Images of Iron Range specimens of *Y. algina* were kindly supplied by R. Eastwood (HUC), G. Thompson (QM) and K. Walker (MV). This paper partially fulfils the requirements for a Master of Philosophy degree undertaken by the author at The University of Queensland, Brisbane.

References

ATLAS OF LIVING AUSTRALIA. 2019. [Accessed 5 July 2019]. *https://bie.ala.org.au//search?q=Hemigraphis*

BRABY, M.F. 2000. *Butterflies of Australia: their identification, biology and distribution*. CSIRO publishing, Collingwood; xx + 976 pp.

LAMBKIN, T.A. and KENDALL, R. 2016. The status of *Yoma algina* (Boisduval, 1832) and *Y. sabina* (Cramer, 1780) (Lepidoptera: Nymphalidae: Nymphalinae) in Australia. *Australian Entomologist* **43**: 211-234.

PARSONS, M.J. 1998. *The butterflies of Papua New Guinea: their systematics and biology.* Academic Press, London; xvi + 736 pp, xxvi + 136 pls.

STANTON, D.J., FELL, D.G. and GOODING, D.O. 2008. *Vegetation communities and regional ecosystems of the Torres Strait islands, Queensland, Australia*. Final report to Torres Strait Regional Authority Land & Sea Management Unit; 3D Environmental®, v + 235 pp.

TENNENT, W.J. 2002. *Butterflies of the Solomon Islands: systematics and biogeography*. Storm Entomological Publications, Dereham, Norfolk; 413 pp, 90 pls.

TORRES STRAIT REGIONAL AUTHORITY. 2013. *Profile for management of the habitats and related ecological and cultural resource values of Dauan Island, January 2013*. Prepared by 3D Environmental® for Torres Strait Regional Authority Land & Sea Management Unit. vi + pp 7-123.

A FURTHER RECORD OF *CHARAXES MARKI* LANE & MÜLLER, 2006 (LEPIDOPTERA: NYMPHALIDAE: CHARAXINAE) FROM TIMOR LESTE

TREVOR A. LAMBKIN

School of Biological Sciences, University of Queensland, St Lucia, Qld 4072

(*Email: trevor.lambkin@uqconnect.edu.au, t.lambkin@hotmail.com*)

Abstract

A further male and female of *Charaxes marki* Lane & Müller, 2006 are recorded from Saburai Village, Timor Leste (-9.71° 125.206°) and notes on the butterfly's observed behaviour and habitat are provided.

Introduction

Until recently, *Charaxes marki* Lane & Müller, 2006 was known only from the holotype male collected NW of Bobonaro in southwestern Timor Leste (Lane and Müller 2006) and from several males and a single, newly described female from just east of Atambua in Indonesian Timor, approximately 40 km south-west of the type locality (Turlin 2015). In November 2018, the present author collected an additional pair of *C. marki* (Figs 1-2) in the Saburai district of Timor Leste, at approximately 900 m elevation roughly 9 km SSW of Maliana and not far from the type locality. Here, I report on the collection of the two specimens and provide field observations.

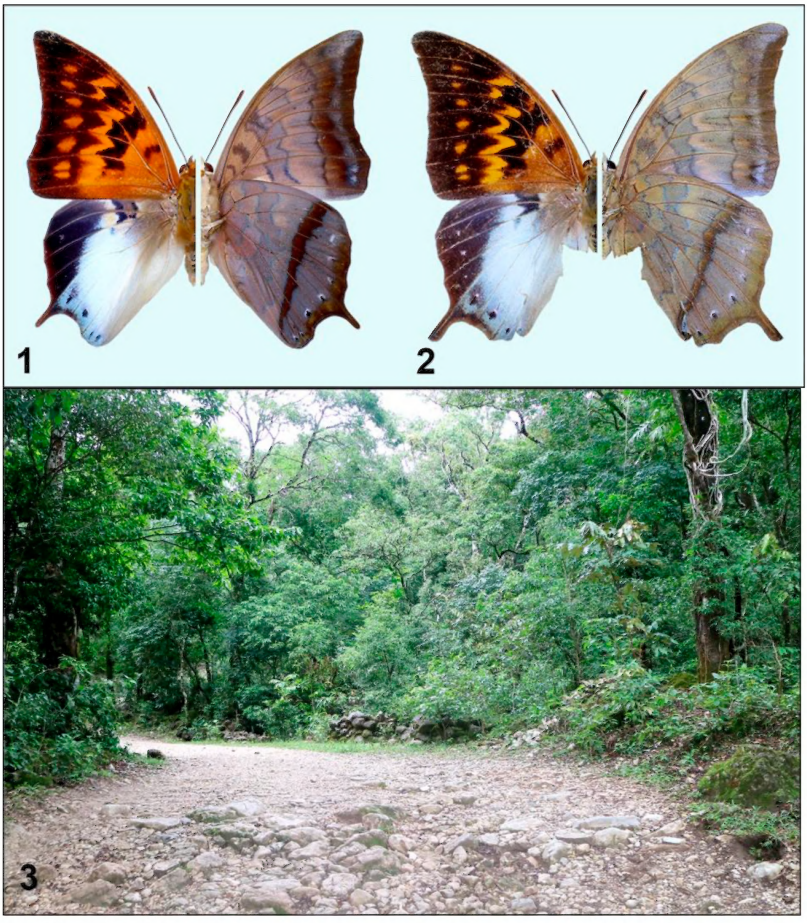
Material examined

TIMOR LESTE: 1 ♂, Saburai district, 900 m, 9 km SSW of Maliana, -9.71° 125.206°, 24.xi.2018, T.A. Lambkin; 1 ♀, same data except 21.xi.2018. Both in joint collection of T.A. Lambkin and A.I. Knight, Brisbane.

Field notes

The northern tip of Saburai Mountain lies approximately 7 km SE of Maliana and about 5 km NW of Bobonaro (the type locality of *C. marki*). The mountain stretches for about 13 km in a NE-SW direction at an elevation of approximately 1800 m. A substantial proportion of it is covered in tropical forest, primarily monsoonal, tending to rainforest. On the northwestern face, a newly constructed road traverses Saburai Village at an elevation of 900-1000 m. The road to Saburai Village and beyond has made ready access to these areas possible only since 2016. Forest grows very close to the village road in places and at one site occurs on both sides of the road.

At this site a male and female (Figs 1-2) were collected along the edge of forest bordering the road (Fig. 3). The male was patrolling a territory along the side of the road where it flew low and perched head downwards on a short tree (*ca* 4 m above the ground) beside the road. Several specimens of *C. orilus* Butler, 1869, another Timor endemic (Tsukada 1991), were observed in the same area.



Figs 1-3. *Charaxes marki* and its habitat from Saburai District, Timor Leste; figures 1-2 not to scale; uppersides left, undersides right [forewing lengths in square brackets]: (1) male, 21.xi.2018 [39 mm]; (2) female, 24.xi.2018 [45 mm]; (3) habitat.

Lane and Müller (2006) collected the holotype hill-topping on the summit of a limestone ridge NW of Bobonaro at an elevation of 1000 m, while Turlin (2015) recorded it at an elevation of 600-800 m in Indonesian Timor. The discovery of the two specimens reported here further supports the premise made by Müller *et al*. (2010) that the primary habitat for *C. marki* is likely to be tropical monsoon or rainforest at moderate altitudes (*ca* 600- 1000 m). The species is still only known from a localised area in the central region of Timor Island as indicated by Turlin (2015).

Acknowledgements

I thank the Catholic brothers of the Missionaries of the Poor, Timor Leste Mission, who are undertaking humanitarian work in Saburai Village, for their assistance during my visits to Timor Leste. I also thank G.B. Monteith for his assistance with several references.

References

LANE, D.A. and MÜLLER, C.J. 2006. A new species of *Charaxes* Oschsenheimer (Lepidoptera: Nymphalidae) from East Timor. *Australian Entomologist* **33**: 71-76.

MÜLLER, C.J., WAHLBERG, N. and BEHEREGARAY, L.B. 2010. 'After Africa': the evolutionary history and systematics of the genus *Charaxes* Ochsenheimer (Lepidoptera: Nymphalidae) in the Indo-Pacific region. *Biological Journal of the Linnean Society* **100**: 457-481.

TSUKADA, E. 1991. Nymphalidae (II). In: *Butterflies of the South East Asian Islands*. Vol V. Azumino Butterflies Research Institute (Azumino B.R.I.), Japan; 576 pp.

TURLIN, B. 2015. Note sur *Charaxes marki* Lane & Müller, 2006 et description de la femelle. *Lépidoptères - Revue des Lépidoptéristes de France* **24**: 1-6.

NEW AUSTRALIAN RECORDS FOR SUBSPECIES OF NYMPHALIDAE AND LYCAENIDAE (LEPIDOPTERA) FROM DAUAN ISLAND, TORRES STRAIT, QUEENSLAND

I.R. JOHNSON[1] and P.R. WILSON[2]

[1]*260 Grassdale Road, Gumdale, Qld 4154*

[2]*2 Billabong Drive, Bundaberg, Qld 4670*

Abstract

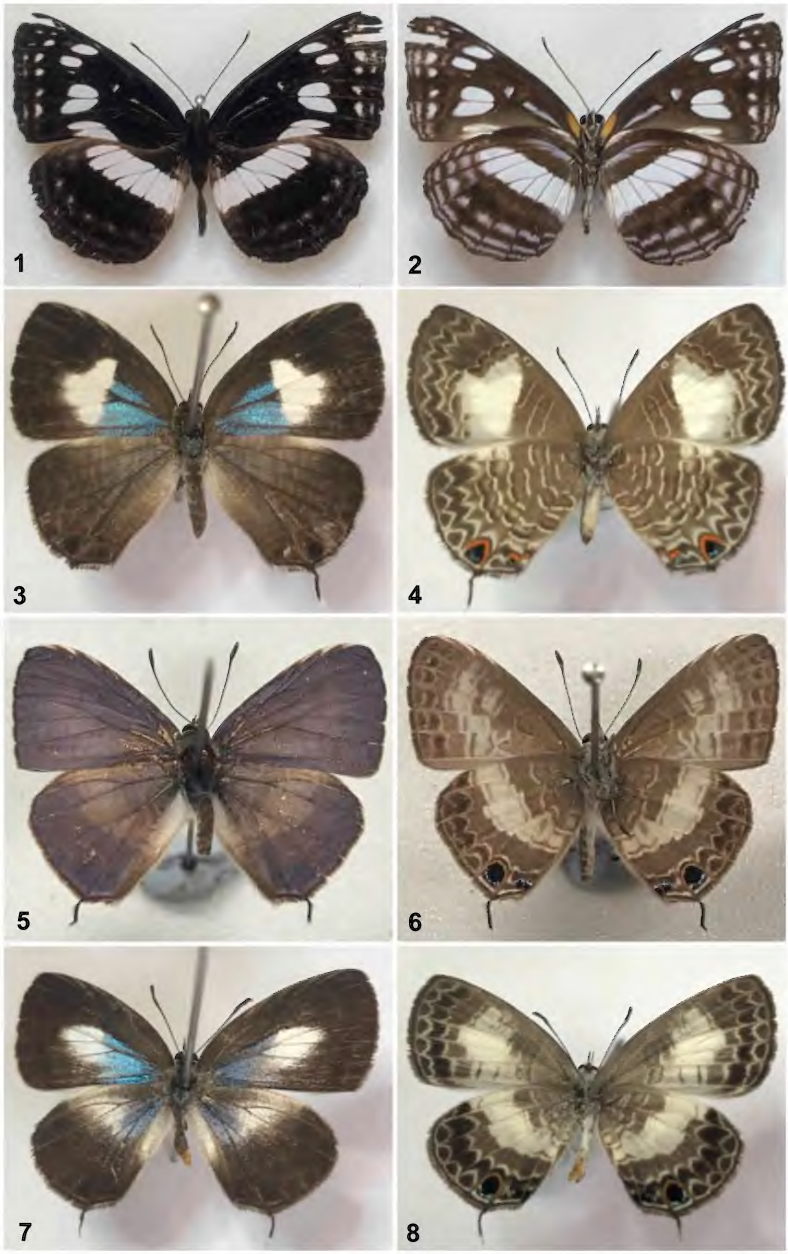
First Australian records of *Phaedyma shepherdi damia* Fruhstorfer, 1905 (Nymphalidae), *Erysichton lineata meiranganus* (Röber, 1886) and *Nacaduba kurava cyaneira* Fruhstorfer, 1916 (Lycaenidae) are reported from Dauan Island in northern Torres Strait. The collected specimens are compared with mainland Australian examples of *P. s. shepherdi* (Moore, 1858), *E. l. lineata* (Murray, 1874), *N. k. felsina* Waterhouse & Lyell, 1914 and *N. k. parma* Waterhouse & Lyell, 1914.

Introduction

Dauan Island (9º25'07"S, 142º31'44"E; WGS 84) is the smallest of the northwestern Torres Strait Islands, 2.85 km long and 2.7 km wide. It is dominated by Mount Cornwallis, a nearly 300 m granite peak covered in dense, mostly impenetrable monsoonal vine scrub. A small fringe of strand vegetation and mangroves occurs on the north to northwestern side of the island, which lies 11 km from the southern coastline of Papua New Guinea (PNG). Its lush vegetation, towering peak and proximity to PNG on its northern aspect make Dauan an attractive habitat for butterflies.

Within Australian limits, 10 butterfly species or subspecies are known so far only from Dauan: *Graphium codrus* (Cramer, 1777), *Cyrestis achates* Butler, 1865, *Taenaris myops* (C. & R. Felder, 1860), *Paraduba metriodes* (Bethune-Baker, 1911) and *Prosotas gracilis* (Röber, 1886) (Braby 2016), *Telicota* sp. nr. *kezia* Evans, 1949 (Lambkin 2015), *Euploea wallacei melia* Fruhstorfer, 1904 and *Euploea stephensii jamesi* (Butler, 1876) (Lambkin 2016), *Papilio euchenor euchenor* Guérin-Méneville, 1830 (Wilson and Johnson 2018) and *Cephrenes augiades bruno* Evans, 1935 (Johnson and Wilson 2019). Seven additional PNG species or subspecies not known south of other northern Torres Strait islands (*e.g.* Saibai, Boigu, Mer [Murray], Erub [Darnley]) have also been recorded from Dauan: *Cethosia cydippe damasippe* (C. & R. Felder, 1867) (Lambkin and Johnson 2015), *Anthene seltuttus seltuttus* (Röber, 1886) and *Anthene lycaenoides setrana* (Fruhstorfer, 1916) (Brown *et al*. 2015), *Nacaduba calauria* (C. Felder, 1860) (Braby 2016), *Eurema blanda saraha* Fruhstorfer, 1912 (Wilson and Johnson 2016), *Parthenos tigrina* (M. Snellen van Vollenhoven, 1886) (Meyer *et al*. 2016) and *Taenaris catops turdula* Fruhstorfer, 1914 (Meyer *et al*. 2017).

The authors visited Dauan in December 2018 for seven days and one of us (I.R.J.) visited again in May 2019. This paper newly records three additional PNG subspecies collected on those visits.


1
2
3
4
5
6
7
8

The following abbreviations refer to repositories from which material has been examined: CEMC – C.E. Meyer Collection, Brisbane; SJJC – S.J. Johnson Collection, located in the Museum of Tropical Queensland, Townsville; SSBC – S.S. Brown Collection, Bowral. Abbreviations of collectors' names are: AIK – A.I. Knight; AJJ – A.J. Johnson; CEM – C.E. Meyer; GCM – G.C. Miller; IRJ – I.R. Johnson; PRW – Peter Wilson; RPW – Richard Weir; SJJ – S.J. Johnson; SSB – S.S. Brown.

***Phaedyma shepherdi damia* Fruhstorfer, 1905**

(Figs 1-2)

Material examined. QUEENSLAND: 1 ♀, Dauan Island, Torres Strait, 16-21.v.2019, IRJ (SJJC).

Description. Wingspan: female 58 mm, slightly smaller than indicated by Parsons (1998). *Phaedyma s. damia* is similar to *P. s. shepherdi* (Moore, 1858) from Moa and Thursday Is in Torres Strait and eastern Australia but differs by having larger postmedial and subterminal white spots and larger spots near the dorsum on the forewing upperside (Fig. 1). The hindwing underside of *P. s. damia* (Fig. 2) has a series of distinct white subterminal spots while the white central band is broader and distinctly larger between veins Rs and M_1 than that of *P. s. shepherdi*.

***Erysichton lineata meiranganus* (Röber, 1886)**

(Figs 3-4)

Material examined. QUEENSLAND: 1 ♀, Dauan Island, Torres Strait, 13-20.xii.2018, IRJ (SJJC).

Description. Wingspan: female 27 mm. When compared with *E. l. lineata* (Murray, 1874) from the Australian east coast, *E. l. meiranganus* is roughly the same size (Parsons 1998, Braby 2000), has the forewing upperside central white patch more restricted and the hind wing uniformly dark grey with the basal area having a few scattered pale blue scales and two obscure black spots near the tail (Fig. 3); the underside (Fig. 4) ground colour is brown-grey with a series of spots and bands distinctly edged with white; forewing with the broad white central area slightly reduced, particularly towards the costa, two small postmedial spots on the edge of the white area towards the tornus and a distinct small circular medial spot edged with white adjacent to the costa; hind wing with a distinct white area on the costa.

Figs 1-8. Butterflies from Dauan Island. (1-2) *Phaedyma shepherdi damia* female, 16-21.v.2019, IRJ: (1) upperside; (2) underside. (3-4) *Erysichton lineata meiranganus* female, 13-20.xii.2018, IRJ: (3) upperside; (4) underside. (5-8) *Nacaduba kurava cyaneira*: (5) male upperside (6.iii.2005, SJJ and IRJ); (6) underside; (7) female upperside (13-20.xii.2018, IRJ); (8) underside.

Nacaduba kurava cyaneira Fruhstorfer, 1916

(Figs 5-8)

Material examined. QUEENSLAND: 3 ♂♂, Dauan Island, Torres Strait, 4.iii.2005, SJJ and IRJ (SJJC); 3 ♂♂, Dauan Island, Torres Strait, 5.iii.2005, SJJ and IRJ (SJJC); 1 ♂, Dauan Island, Torres Strait, 6.iii.2005, SJJ and IRJ (SJJC); 1 ♂, Dauan Island, Torres Strait, 16-20.iv.2015, SSB (SSBC); 1 ♀, Dauan Island, Torres Strait, 22-29.i.2016, CEM, SSB, RPW and CGM (CEMC); 1 ♀, Dauan Island, Torres Strait, 3-10.iii.2016, IRJ and PRW (SJJC); 1 ♀, Dauan Island, Torres Strait, 13-20.xii.2018, IRJ (SJJC).

Description. Wingspan: male 28 mm, female 26 mm. Females from Dauan are slightly smaller than indicated by Parsons (1998). When compared with *N. k. parma* Waterhouse & Lyell, 1914 from Queensland and *N. k. felsina* Waterhouse & Lyell, 1914 from the Northern Territory, the *N. k. cyaneira* male upperside (Fig. 5) is similar but lacks the white patch on the hindwing costa that usually occurs in *N. k. parma*, while the underside broad irregular white medial band is more restricted than in *N. k. parma* (Fig. 6), particularly on the forewing, and more distinct than in *N. k. felsina*. The female upperside (Fig. 7) is brown-black, with the white central area on both wings more restricted and the hind wing with a very obscure black spot near the tail; underside (Fig. 8) similar except ground colour grey with the white medial band more restricted on the forewing than in *N. k. parma* but more extensive on the hind wing than in *N. k. felsina* and with distinctly darker marginal and submarginal lunules.

Discussion

Phaedyma s. damia occurs throughout mainland PNG and adjacent islands and its external facies are very similar to those of *P. s. shepherdi* (Parsons 1998). The single specimen taken on Dauan in May 2019 (Figs 1-2) was patrolling the mangrove fringe on the northwestern shoreline and had the same gliding flight pattern as the nominate race. Sightings of black and white medium-sized nymphalids in previous years by IRJ and AIK (pers. comm.) might have been this species. Geographically, the closest records of *P. s. shepherdi* in Australia are from Moa Island, approximately 80 km south of Dauan Island.

Erysichton lineata (Murray, 1874) occurs from Maluku and Kai Is in eastern Indonesia, throughout mainland New Guinea and adjacent islands, to the Bismarck Archipelago, Solomon Islands and eastern Australia (Parsons 1998). Subspecies *E. l. lineata* is restricted to the east coast of Australia from Cape York in Queensland to Kiama in New South Wales (Braby 2000), while *E. l. meiranganus* occurs throughout mainland New Guinea and its adjacent islands (Parsons 1998). The single female collected in December 2018 on Dauan (Figs 3-4) was feeding on mango blossom on the edge of monsoonal vine scrub. The specimen was compared with both *E. l. lineata* and *E. l. meiranganus* to confirm its subspecies status.

The distinguishing features of *E. l. meiranganus*, when compared with *E. l. lineata* from mainland Queensland, are the lack of blue iridescent scaling on the basal area of the hindwing upperside and the different shape and extent of the forewing underside white patch and associated bands and spots. The external facies of the Dauan specimen agrees with that illustrated by Parsons (1998); the central white patch on the forewing upperside is more restricted in size but this might be due to seasonal variation. Geographically, the closest records of *E. lineata* in Australia are from Cape York Peninsula, approximately 140 km south of Dauan Island, while *E. l. meiranganus* occurs throughout mainland PNG (Sands and Fenner 1978, Parsons 1998), just 11 km to the north of Dauan.

Nacaduba kurava (Moore, 1858) ranges from southern India and Sri Lanka, throughout Southeast Asia, mainland New Guinea and adjacent islands, to the Bismarck Archipelago, Solomon Islands and Australia. In Australia, *N. k. felsina* occurs in the Northern Territory and *N. k. parma* is in the east, occurring from Moa Island in Torres Strait to Grafton in NSW (Braby 2000). In PNG, *N. k. cyaneira* occurs throughout the mainland (Parsons 1998). A series of seven males first collected by SJJ and IRJ on Dauan Island in 2005 were tentatively assigned to the PNG subspecies *N. k. cyaneira.* The collection of two females from Dauan, in March 2016 (IRJ and PRW) and December 2018 (IRJ) on the edge of monsoonal vine scrub, has enabled comparison of both sexes with the Australian and PNG subspecies.

Braby (2000) indicated Moa Island as the northern recorded limit for *N. k. parma*, which is approximately 80 km south of Dauan, while *N. k. cyaneira* occurs throughout mainland PNG and on the adjacent islands of Goodenough, Samara and Manus (Parsons 1998). The availability of both sexes from Dauan (Figs 5-8) has assisted in confirming the original suspicion that they were *N. k. cyaneira*. When compared with *N. k. parma* from Queensland and *N. k. felsina* from the Northern Territory, Dauan specimens can be separated by the different extent and shape of the underside broad, irregular white medial band and the underside ground colour, particularly in females (Fig. 8). Braby (2000) recognised seasonal variation in the extent of the central white area of the female forewing upperside of the Australian subspecies. The distinct marginal and submarginal lunules of the Dauan female underside might also represent seasonal variation, as noted by Braby (2000) for the NT subspecies.

Acknowledgements

The authors wish to thank the local community and council of Dauan Island, especially Chairman Torenzo Elisala, for allowing entry into their community and providing assistance during our stay. Accommodation was provided by Tagai College with the kind assistance of Barb Mead. We also wish to thank Robyn Cumming for her assistance in locating and photographing specimens in the Museum of Tropical Queensland, Townsville. Steve Brown and Cliff

Meyer were generous in the provision of specimens in their care for comparison.

References

BRABY, M.F. 2000. *Butterflies of Australia: their identification, biology and distribution*. CSIRO Publishing, Melbourne; xx + 976 pp.

BRABY, M.F. 2016. *The complete field guide to butterflies of Australia*. 2nd edn. CSIRO Publishing, Clayton South; 382 pp.

BROWN, S.S., MEYER, C.E. and WEIR, R.P. 2015. The first records of *Anthene seltuttus seltuttus* (Röber, 1886) and *Anthene lycaenoides sutrana* (Fruhstorfer, 1916) (Lepidoptera: Lycaenidae: Polyommantinae) from northern Torres Strait, Queensland, Australia. *Australian Entomologist* **42**(2): 63-66.

JOHNSON, I.R. and WILSON, P.R. 2019. New Australian records of *Cephrenes augiades bruno* Evans, 1935 (Lepidoptera: Hesperiidae) and *Hypolimnas bolina nerina* (Fabricius, 1775) female form *pallescens* Poulton, 1924 (Lepidoptera: Nymphalidae) from Dauan Island, Torres Strait, Queensland. *Australian Entomologist* **46**(1): 15-22.

LAMBKIN, T.A. 2015. *Telicota* sp. nr. *kezia kezia* Evans, 1949 (Lepidoptera: Hesperiidae: Hesperiinae) from Dauan Island, Torres Strait, Queensland. *Australian Entomologist* **42**(2): 257-263.

LAMBKIN, T.A. 2016. First Australian records of *Euploea wallacei melia* Fruhstorfer, 1904 and *Euploea stephensii jamesi* Butler 1876 (Lepidoptera: Nymphalidae: Danainae) from Dauan Island, Torres Strait, Queensland, with notes on the aggregation habits of *Euploea* Fabricius species near flowering mangroves. *Australian Entomologist* **43**(2): 55-68.

LAMBKIN, T.A. and JOHNSON, S.J. 2015. *Cethosia cydippe damasippe* C. & R. Felder, 1867 (Lepidoptera: Nymphalidae: Heliconiinae) in Torres Strait, Queensland, Australia. *Australian Entomologist* **42**(2): 67-72.

MEYER, C.E., BROWN, S.S., KNIGHT, A.I. and BROWN, A.L. 2017. First record of *Taenaris catops turdula* Fruhstorfer, 1914 (Lepidoptera: Nymphalidae: Amathusiinae) from Dauan Island, Torres Strait, Queensland. *Australian Entomologist* **44**(1): 25-28.

MEYER, C.E., MILLER, C.G., BROWN, S.S. and WEIR, R.P. 2016. First Australian record of *Parthenos tigrina* (M. Snellen van Vollenhoven, 1886) (Lepidoptera: Nymphalidae: Nymphalinae). *Australian Entomologist* **43**(3): 113-118.

PARSONS, M. 1998. *The butterflies of Papua New Guinea. Their systematics and biology.* Academic Press, London; xvi + 900 pp.

SANDS, D.P.A. and FENNER, T.L. 1978. New butterfly records from the New Guinea region. *Australian Entomological Magazine* **4**(6):101-108.

WILSON, P.R. and JOHNSON, I.R. 2016. *Eurema blanda saraha* Fruhstorfer (Lepidoptera: Pieridae: Coliadinae) rediscovered in Torres Strait, Queensland. *Australian Entomologist* **43**(4): 235-237.

WILSON, P.R. and JOHNSON, I.R. 2018. New Australian records for *Papilio euchenor euchenor* Guérin-Méneville, 1830 and form *ambracia* Wallace, 1865 of *Papilio ambrax ambrax* Boisduval, 1832 (Lepidoptera: Papilionidae) from Dauan Island, Torres Strait, Queensland. *Australian Entomologist* **45**(1): 47-49.

BOLBOLEAUS HOUSTONI HOWDEN, 1985 (SCARABAEOIDEA: GEOTRUPIDAE: BOLBOCERATINAE): DIAGNOSIS OF THE FEMALE, PLACEMENT IN A KEY AND NOTES ON DISTRIBUTION AND HABITAT

PAUL M. HUTCHINSON[1] and PETER G. ALLSOPP[2]

[1]*Department of Primary Industries and Regional Development (Quarantine WA), Locked Bag 69, Welshpool DC, WA 6986* (*Email: paul.hutchinson@dpird.wa.gov.au*)

[2]*Queensland Museum, PO Box 3300, South Brisbane, Qld 4101* (*Email: peter.allsopp@bigpond.com*)

Abstract

The female of *Bolboleaus houstoni* Howden, 1985, is recorded for the first time and characters are provided to distinguish it from females of related species. Howden's key to females of *Bolboleaus* Howden & Cooper is modified to accommodate it. The species' distribution appears to be restricted to the area around Cue, Western Australia and adult activity during September, January and March presumably occurs in response to rainfall.

Introduction

In the last 50 years, the bolboceratine earth-borer beetles have had a chequered placement – a tribe within the scarabaeid subfamily Geotrupinae (Howden and Cooper 1977, Howden 1985), a subfamily of the Geotrupidae (Britton 1970, Cassis and Weir 1992, Verdú *et al.* 2004, Smith 2006, Smith *et al.* 2006, Howden *et al.* 2007, Bouchard *et al.* 2011, Lawrence and Ślipiński 2013) and a tribe within the Bolboceratidae (Scholtz and Browne 1996, Gussmann and Scholtz 2000, Scholtz and Grebennikov 2005). Morphological characters point to the last arrangement, while preliminary DNA analysis (Smith *et al.* 2006) was inconclusive but leant towards the second. We follow the second and reflect it in the title of this paper. At the generic level the Australian fauna is the richest in the world, with 10 of about 40 genera (Scholtz and Browne 1996); this is based on a comprehensive review of the genera (Howden and Cooper 1977) and associated reviews of each genus, mainly by Howden in the 1970s-90s.

Bolboleaus Howden & Cooper, 1977 comprises 14 species divided into two groups based on the shape of the aedeagus and the pronotum of major males (Howden 1985). Major males exhibit well developed head and pronotal horns that are diagnostic. Females lack such ornate structures and are diagnosed instead by cephalic carinae, nodes and the pronotal carina and punctuation. The genus is represented in all mainland States and the Northern Territory, particularly in drier areas, with seven species known from Western Australia (Howden 1985). Adults tend to be active above ground later than most other sympatric genera, usually during moist periods in spring and summer (Howden 1985). Females have been described for all species except *B. houstoni* Howden, 1985.

Here, we provide diagnostic characters for the female of *B. houstoni* and provide notes on the distribution and biology of the species. Morphological

characters and terminology follow Howden (Howden and Cooper 1977, Howden 1985), thus maintaining consistency and allowing direct comparison with publications that provide a foundation for studies on Australian Bolboceratinae. For example, we have retained the term 'node' rather than using the alternative 'tubercle'. Gussmann and Scholtz (2000) used the same terminology for the southern African genera of Bolboceratinae.

Abbreviations. PMH – Paul Hutchinson collection, Perth; WAM – Western Australian Museum, Perth. A single slash indicates data on the reverse of labels and a double slash indicates separate labels.

Illustrations. PMH examined specimens using a Nikon SMZ 745 Microscope. Photographs were taken with a Canon EOS 7D camera with an MPE 65 mm macro lens, using a Visionary Digital Passport 2 Imaging system, and the multiple stacks composited using Helicon Focus software. Measurements were made using digital electronic callipers accurate to 0.01 mm.

***Bolboleaus houstoni* Howden, 1985**

(Figs 1-4)

Bolboleaus houstoni Howden, 1985: 21, figs 4, 49-51; Cassis and Weir, 1992: 55; Howden *et al.*, 2007: 51, 56.

Type. Holotype ♂, 20 km south of Cue, Western Australia, 4.ix.1980, C.A. Howard and T.F. Houston, at light at night; in WAM (not examined).

Material examined. AUSTRALIA (WESTERN AUSTRALIA): 2 ♂♂, 2 ♀♀, Milly Soak Stn. *ca* 20 km N. of Cue, 28 Jan. 2006, P. Hutchinson / *Bolboleaus houstoni* to light // PMH Coll # Bolb 0277, 0274, 0275, 0278 [PMH]; 4 ♀♀, 20 km N. of Cue [Milly Soak Stn.], 28.Jan.2006, P. Hutchinson / *Bolboleaus houstoni* to light // PMH Coll # Bolb. 0282, 0286, 0290, 0291 [PMH]; 4 ♂♂, 5 ♀♀, 17 km S. of Cue (Grt. N. Hwy), 9.Mar.2011, P. Hutchinson and A. Sundholm / *Bolboleaus houstoni* on red dunes to ULP Lamp // PMH Coll # Bolb 0281, 0284, 0285, 0289, 0276, 0279, 0283, 0287, 0292 [PMH, WAM]; 1 ♂, 1 ♀, 2 km WSW of Cue, 10.Mar.2011, P. Hutchinson and A. Sundholm / *Bolboleaus houstoni* to ULP Lamp // PMH Coll # Bolb 0288, 0293 [PMH].

Identification. Howden (1985) placed *B. houstoni* in his *tenax* species group close to *B. quadrifoveatus* (Lea, 1919) and *B. mimus* Howden, 1985; the males of all three species have an upright median horn with a rounded apex on the vertex and are distinctive. Howden predicted that females of *B. houstoni* would most closely resemble those of *B. mimus*, given the close similarity of the males, and suggested they would run to *B. mimus* in his key.

During trips to the Cue area in Western Australia after summer rainfall, PMH collected several species of bolboceratines, including *B. truncatus* (Blackburn, 1904), *B. parvicollis* Howden, 1985 and *B. houstoni*. All male specimens were identified to species using Howden's (1985) keys and descriptions. However, several females that keyed to *B. tenax* (Blackburn,

Figs 1-2. *Bolbolaeus* spp females, head and pronotum: (1) *B. houstoni* – arrow shows position of conjoined punctures where a fossa is on *B. mimus*; (2) *B. tenax*.

1904), a species known from southern Australia, did not conform to the description of that species. We associated them with males of *B. houstoni* taken at the same time and location.

Diagnosis of female (Fig. 1). Length 16.7-19.8 mm (mean 18.1 mm), width 10.7-12.7 mm (mean 11.3 mm), n = 12. Anterior lateral carina of clypeal carina extending to the anterolateral margin of the clypeus; vertex of clypeus with a binodose node with the depression separating the nodes distinctly less than the width of each node; obtuse node above each antennal insertion. Pronotum on each side behind eye with a shallow indentation composed of 2-3 conjoined punctures; pronotal carina complete without nodes laterad to the

lateral termination; lateral pronotal margin near posterior angle smooth to slightly irregular. Prosternum posteriorly behind fore coxae with slanted face without distinct tubercles.

Females of *B. houstoni* conform to Howden's (1985) description of *B. tenax* females, except for the structure of the cephalic node. Females of *B. tenax* have the binodose node on the vertex with the depression separating the nodes equal to the width of each node (Fig. 2); in *B. houstoni* the depression separating the nodes is distinctly less than the width of a node (Fig. 1).

Females of *B. quadrifoveatus* have a simple node on the vertex, a narrow clypeal carina (0.3x width of clypeus), an acute node above each antennal insertion and the pronotal carina bilobed with a short node laterad to the lateral termination. In *B. houstoni* the node on vertex is binodose, the clypeal carina is broad (0.5x width of clypeus), there is an obtuse node above each antennal insertion and the pronotal carina is complete without nodes laterad to the lateral termination (Fig. 1).

Females of *B. mimus* have a deep fossa at the anterior margin of pronotum adjacent to each eye (Howden 1985, fig. 46). In *B. houstoni* the pronotal fossae are shallow and each is composed of 2-3 conjoined punctures (Fig. 1).

Howden's (1985) key to females of *Bolboleaus* can be modified to accommodate the female of *B. houstoni* by replacing couplet 11 with the following:

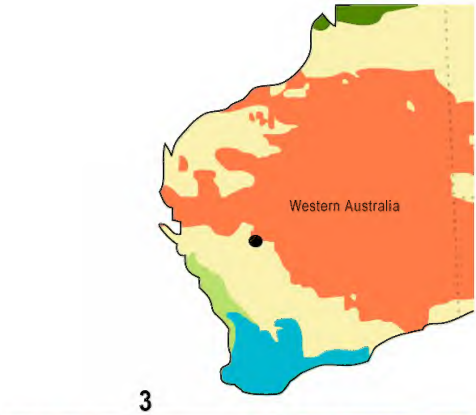
11(10) Lateral pronotal margin near posterior angle distinctly serrate 12

Lateral pronotal margin near posterior angle smooth to slightly irregular. NSW, Vic, SA, WA 11a

11a(11) Depression separating nodes of cephalic tubercle equal to 1 node in width (Fig. 2). NSW, Vic, SA, se WA ..... 12. *tenax* (Blackburn)

Depression separating nodes of cephalic tubercle less than 1 node in width (Fig. 1). WA (Cue district) ..... 11. *houstoni* Howden

Distribution and habitat. All specimens of *B. houstoni* have been recorded from within 20 km of Cue (27.43°S, 117.90°E), Western Australia (Fig. 3). The type series of three males was taken on 4 September 1980 in a sandy area interspersed with saltpans 20 km south of Cue, at light at night. The Milly Soak Station series was taken on 28 January 2006 alongside a shallow creek lined with *Eucalyptus* sp. on a flat limestone landscape with an *Acacia*-dominant plant community; rainfall was not recorded. The series collected 17 km south of Cue on 9 March 2011 came from red dunes beside a saltpan dominated by *Acacia* spp (Fig. 4) and was attracted to unleaded petrol-fuelled pressure lamps after recent rain. The 10 March 2011 series was taken 2 km WSW of Cue after recent rain in hard sand with granite dispersed on surface (possibly due to historic mining activity) alongside a creekbed with ponds, in flat country dominated by *Acacia* spp.



Figs 3-4. *Bolboleaus houstoni* distribution and habitat: (3) distribution map: Köppen classification shown – brown = desert; light yellow = grassland; (4) landscape at 17 km south of Cue where *B. houstoni* was collected.

PMH and Allen Sundholm also conducted light-trapping at 'The Granites', 10 km north of Mount Magnet on 8 March 2011, at 57 km north of Meekatharra on 11 March 2011 and at 157 km north of Meekatharra on 12 March 2011, all following the same recent rain as closer to Cue, but *B. houstoni* was not encountered at these locations although *B. truncatus* and *B. parvicollis* were. It appears that *B. houstoni* has a limited distribution around Cue and adults have been recorded during September, January and March; they most likely respond to rainfall. It co-exists with its closely related congeners *B. truncatus* and *B. parvicollis* but is allopatric with *B. quadrifoveatus* (Queensland), *B. mimus* (Northern Territory) and *B. tenax* (New South Wales, Victoria, South Australia and SE Western Australia) (Howden 1985). This assists in determining the identity of females.

Acknowledgements

PMH thanks the Department of Biosecurity, Conservation and Attractions for collecting permits. We thank Allen Sundholm, who accompanied PMH during the 2011 trip and for the image of the habitat, and Nic Tatarnic and Brian Hanich (WAM) for access to collections and the use of the photostacking camera at WAM.

References

BOUCHARD, P., BOUSQUET, Y., DAVIES, A.E., ALONSO-ZARAZAGA, M.A., LAWRENCE, J.F., LYAL, C.H.C., NEWTON, A.F., REID, C.A.M., SCHMITT, M., ŚLIPIŃSKI, S.A. and SMITH, A.B.T. 2011. Family-group names in Coleoptera (Insecta). *ZooKeys* **88**: 1-972.

BRITTON, E.B. 1970. Coleoptera (beetles). Pp 495-621, in: CSIRO (ed), *The Insects of Australia. A textbook for students and research workers.* Melbourne University Press, Carlton.

CASSIS, G. and WEIR, T.A. 1992. Geotrupidae. Pp 41-64, in: Houston, W.W.K. (ed), *Zoological Catalogue of Australia. Coleoptera: Scarabaeoidea*. Volume 9. AGPS, Canberra.

GUSSMANN, S.M.V. and SCHOLTZ, C.H. 2000. Systematic revision of endemic southern African genera of Bolboceratinae (Coleoptera: Scarabaeoidea: Bolboceratidae). *Journal of Natural History* **34**: 1045-1123.

HOWDEN, H.F. 1985. A revision of Australian beetle genera *Bolboleaus* Howden & Cooper, *Blackbolbus* Howden & Cooper, and *Bolborhachium* Boucomont (Scarabaeidae: Geotrupinae). *Australian Journal of Zoology, Supplementary Series* **111**: 1-179.

HOWDEN, H.F. and COOPER, J.B. 1977. The generic classification of the Bolboceratini of the Australian Region, with descriptions of four new genera (Scarabaeidae: Geotrupinae). *Australian Journal of Zoology, Supplementary Series* **50**: 1-50.

HOWDEN, H., HOWDEN, A. and HOLLOWAY, G. 2007. Digging down under: Australian Bolboceratini, their habits and a list of species (Coleoptera: Scarabaeoidea: Geotrupidae). *Zootaxa* **1499**: 47-59.

LAWRENCE, J.F. and ŚLIPIŃSKI, A. 2013. *Australian beetles: morphology, classification and keys.* Volume 1. CSIRO Publishing, Collingwood.

SCHOLTZ, C.H. and BROWNE, D.J. 1996. Polyphyly in the Geotrupidae (Coleoptera: Scarabaeoidea): a case for a new family. *Journal of Natural History* **30**: 597-614.

SCHOLTZ, C.H. and GREBENNIKOV, V.V. 2005. Scarabaeoidea. Pp 367-374, in: Kristensen, N.P. and Beutel, R.G. (eds), *Handbuch der Zoologie. Band IV. Arthropoda: Insecta. Teilband 38. Coleoptera, beetles. Vol. 1: morphology and systematics.* Walter de Gruyter, Berlin.

SMITH, A.B.T. 2006. A review of the family-group names for the superfamily Scarabaeoidea (Coleoptera) with corrections to nomenclature and current classification. *Coleopterists Society Monograph* **5**: 144-204.

SMITH, A.B.T., HAWKS, D.C. and HEARTY, J.M. 2006. An overview of the classification and evolution of the major scarab beetle clades (Coleoptera: Scarabaeoidea) based on preliminary molecular analyses. *Coleopterists Society Monograph* **5**: 35-46.

VERDÚ, J.R., GALANTE, E., LUMARET, J-P. and CABERO-SAÑUDO, F. 2004. Phylogenetic analysis of Geotrupidae (Coleoptera, Scarabaeoidea) based on larvae. *Systematic Entomology* **29**: 509-523.

A NEW SPECIES OF *AENETUS* HERRICH-SCHÄFFER (LEPIDOPTERA: HEPIALIDAE) FROM TASMANIA, WITH NOTES ON THE *SPLENDENS* GROUP OF SPECIES IN SOUTH AUSTRALIA

ETHAN P. BEAVER

South Australian Museum, Adelaide, SA 5000 (*Email: ethan.beaver@live.com.au*)

Abstract

Aenetus moorei **sp. n.** is described from Tasmania and compared with similar *splendens* group species of *Aenetus* Herrich-Schäffer such as *A. ligniveren* (Lewin, 1805) and *A. tindalei* Simonsen, 2018, which are illustrated. Further collecting of the *splendens* group species in South Australia has clarified aspects of the distribution and biology of both *A. ligniveren* and *A. tindalei* in that State.

Introduction

Aenetus Herrich-Schäffer, 1855 is a genus of large, spectacularly marked stem-boring moths from Indonesia, Papua New Guinea, New Caledonia, New Zealand and the higher rainfall regions of Australia. The *splendens* group comprises five closely related species – *A. splendens* (Scott, 1864), *A. astathes* (Turner, 1915), *A. lewinii* (Walker, 1856), *A. ligniveren* (Lewin, 1805) and *A. tindalei* Simonsen, 2018 – all of which are endemic to Australia, where they occur across much of the southern and southeastern parts of the continent, with one species, *A. astathes*, from southwestern Western Australia. The females of all *splendens* group species share a similar general appearance, including features such as extensive patches of brown type 2 bilayer scale covering on the forewings (Simonsen 2018), often separating or surrounding marginal and discal areas of green, while the males are generally green or yellow with a medial white band on the forewing or other extensive white patterns. The species in this group are among the smallest of the genus.

It was shown by Simonsen (2018), in a revision of the Australian members of the genus, that the *splendens* group includes superficially similar species that can only be separated on genitalia morphology and subtle, sometimes inconsistent, differences in wing patterns, as is the case with the recently described *A. tindalei.* Simonsen remarked on the possibility of a new species occurring in Tasmania and this has led to the recognition of the Tasmanian population as a distinct species. Further investigations into the *splendens* group show *A. tindalei* to be more widespread in South Australia, occurring on the mainland in the Mount Lofty Ranges region as well as on Kangaroo Island, while *A. ligniveren* is confined to the lower south-east of the State.

Methods

Genitalia were dissected as described by Simonsen (2018). The abdomen was removed and placed in 20% KOH solution and heated over a flame for 6-8 minutes before being cleaned with distilled water then stored in ethanol in a labelled vial kept in a tray adjacent to the pinned specimen in SAMA.

Specimens of *A. moorei* **sp. n.**, *A. tindalei* and *A. ligniveren* were collected as larvae from Tasmania and South Australia respectively and reared as described in Beaver and Grehan (2018). Material examined: 76 specimens of *Aenetus ligniveren* (69 in SAMA, 1 in ANIC, 6 in EPB), 34 *A. tindalei* (including holotype female and paratype male, see discussion), 15 *A. moorei* **sp. n.**). Diagrams of adult external and internal genitalia were drawn freehand by tracing images of the dissections, in a similar format to that standardised by Simonsen (2018) for ease of comparison. The resulting drawings were then compared with the dissections to ensure accuracy. Terminology for genitalia and wing morphology also follows Simonsen (2018).

Abbreviations: General: SAMA – South Australian Museum, Adelaide. ANIC – Australian National Insect Collection. TMAG – Tasmanian Museum and Art Gallery. EPB – E. P. Beaver collection. MLR – Mount Lofty Ranges. KI – Kangaroo Island. SA – South Australia. TAS – Tasmania. Morphology: FW – forewing. HW – hind wing. For male genitalia (Figs 11-22): LV – in lateral view. PVV – in posteroventral view. brt – basal rim of pseudotegumen. dpm – distoposterior margin of pseudotegumen. drm – dorsoposterior margin of pseudotegumen. ip – intermediate plate. jx – juxta. pt – pseudotegumen. sac – saccus. S8 – eighth sternite. tpr – twin processes of pseudotegumen. va – vinculum. vl – valva. vpa – ventral pseudoteguminal arm. For female genitalia (Figs 23-28): BC – bursae copulatrix. PVV – posteroventral view. an – anus. cb – corpus bursae. db – ductus bursa. div – diverticulum. dp – dorsal plate. lal – lateral area of antevaginal lamella. mal – medial area of antevaginal lamella. ps – patch of setae (represented by grey crosshatch). sub – subanal plate.

Taxonomy

Family: HEPIALIDAE Stephens, 1829

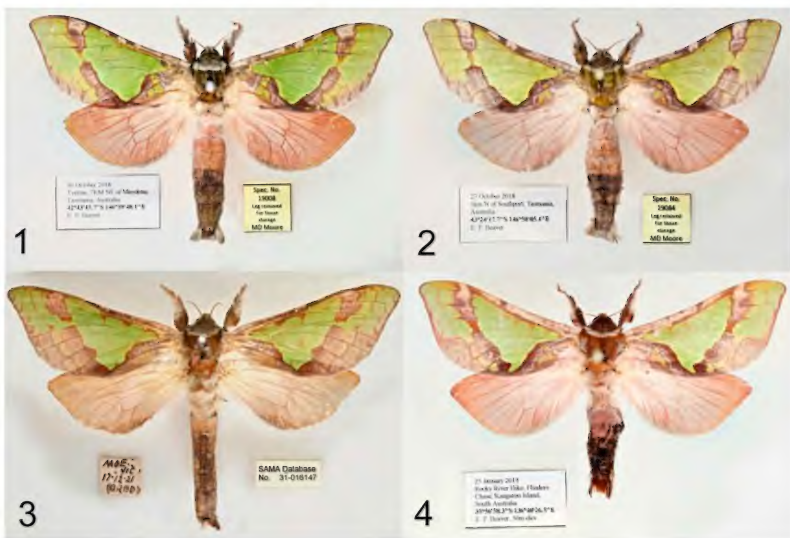
Aenetus moorei sp. n.

(Figs 1-2, 5, 11-14, 23-24, 32-33)

Types. Holotype ♀, AUSTRALIA (TASMANIA): Tyenna, 7 km NE of Maydena, 42°43'45.7"S 146°39'48.1"E, 30 October 2018, E.P. Beaver / larva coll. 03 February 2018, pupated 28 September 2018, eclosed 30 October 2018 / ex. *Pomaderris apetala,* 265 m elev. / Spec. No. 19008, Leg removed for tissue storage, MD Moore (In SAMA). *Paratypes*: 1 ♀, 5 km N of Southport, 43°24'17.7"S 146°58'05.4"E, 27 October 2018, E.P. Beaver / larva coll. 05 February 2018, pupated 28 September 2018, eclosed 27 October 2018 / ex. *Acacia dealbata,* 220 m elev. / Spec. No. 19084, Leg removed for tissue storage, MD Moore (In EPB collection, to be sent to BMNH); 1 ♀, Tyenna, 7 km NE of Maydena, 42°43'45.7"S 146°39'48.1"E, 28 October 2018, E.P. Beaver / larva coll. 03 February 2018, pupated 28 September 2018, eclosed 28 October 2018 / ex. *Nematolepis squamea,* 265 m elev. (In D.A. Lane collection); 1 ♀, Tyenna, 7 km NE of Maydena, 42°43'45.7"S 146°39'48.1"E, 01 November 2018, E.P. Beaver / larva coll. 03 February 2018, pupated 02 October 2018, eclosed 01 November 2018 / ex. *Zieria arborescens,* 265 m elev., 1 ♂, 5 km N of Southport,

43°24'17.7"S 146°58'05.4"E, 28 October 2018, E.P. Beaver / larva collected 05 Feb 2018, pupated 28 September 2018, eclosed 28 October 2018 / Ex. *Eucalyptus regnans*, 220m elev. (Both in EPB collection); 1 ♀, 'Tasmania' / SAMA Database No. 31-016216 / EPB Dissection No. 31-016216; 1 ♂, same data except SAMA Database No. 31-016217 (both in SAMA); 1 ♂, 10 miles E of Marrawah, emg. 11 Nov. 1963, I.F.B. Common & M. S. Upton / 14/63 / EPB Dissection ID. EPB-ANIC-4 (ANIC). ♂, Kingston, 17 December 1946 (bred), J. R. Cunningham, TMAG F02370 / EPB Dissection No. EPB-TMAG-1; 1 ♂, same data, TMAG F02372; 2 ♀♀, same data except 8 December 1959, TMAG F02379, and 12 December 1948, TMAG F02378. Judbury, TAS, 15 December 1980, D. Porthouse, TMAG F11811 / EPB Dissection No. EPB-TMAG-2; 1 ♀, Arthur-Pieman Conservation Area: along Interview R., 41.5823°S 144.8912°E, 02 February 2015, A. Throssell, TMAG F19858 / EPB Dissection No. EPB-TMAG-3; 1 ♀, Snug Tiers, TAS, 25 November 1982, R. Bashford, TMAG F06587. (All six in TMAG).

Other material examined. Two living larvae: February 2019, Wynyard, Tasmania, in *Leptospermum scoparium*, O.F. Hill; 12 April 2019, Emu Heights, 4 km SE of Burnie, Tasmania, in *Nematolepis squamea*, E.P. Beaver & O.F. Hill (both in EPB collection, expected emergence late 2019).



Figs 1-4. Female *Aenetus* spp: *A. moorei* **sp. n.** (1) holotype; (2) paratype; (3) *A. ligniveren* (Lewin); (4) *A. tindalei* Simonsen. (Photos © SAMA).

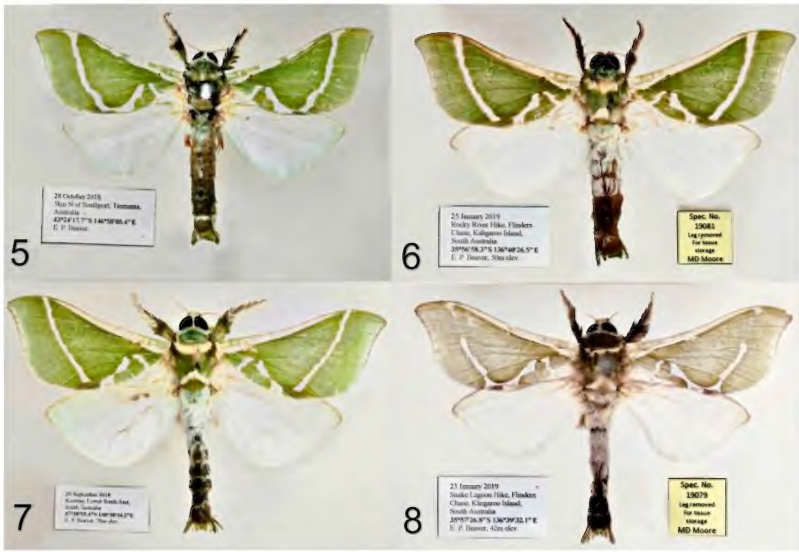
Diagnosis. This is the only *splendens* group species known to occur in Tasmania and appears to be endemic to the main island. This species is superficially most similar to *A. ligniveren* and *A. tindalei*; however, the female is characterised by the structure of the external and internal genitalia, particularly the unique wedge shape of the subanal plates, and by the spots

along the forewing costa which, although present in *A. ligniveren*, appear to be more starkly contrasting in *A. moorei,* and by the irregular light green patch in the basal area of the forewing which is larger and more defined in this species. The green areas of the forewing bear resemblance to *A. splendens* while the forewing shape is shorter and broader than *A. ligniveren,* and similar to that of *A. tindalei.* The male is readily distinguished by the genitalia, particularly the valva shape (rounded swelling distal to the truncate tooth at the tip) and pseudotegumen serrations, as well as a shorter, less angular vinculum. Externally, the males have the white band along the forewing costa broken with green spots.

Description. Female (Fig. 1-2, 23-24, 32-33). Head: Antennae longer than head and slender, filiform, pale brown. Eyes prominent, of roughly same height as head capsule. Scales on frons and vertex dense and grey, obscuring base of antenna. Labial palps three segmented, first segment slightly shorter than second, third segment shortest, rounded. Thorax: pro- and mesothorax dorsally and ventrally covered in fine dark grey-brown scales and interspersed with greenish yellow scales on dorsal surface; band of lighter grey scales from base of wing. Fore and mid legs covered with dense dark brown scales, becoming light grey along tarsus. Hind legs light brown, short. Foreleg tibia with triangular epiphysis. Abdomen: Elongate, broad, segments covered in dense cream scales basally, rust-brown medially and dark brown distally, with long piliform scale tufts at apex. Wings: FW length 26-30 mm, expanse 59-62 mm, broad and triangular. Costa slightly concave centrally and convex towards apex. Apex weakly falcate. Wing venation classically hepialine. HW length 20-23 mm, broad, subtriangular, tornus rounded. FW dorsal ground colour lime green in discal area and distally, a narrow connection in medial area linking both green areas at M1, generally between just beyond Rs4 and above M2. Light brown medial line from just above M2 to tornus and continuing (after green medial connection) to just beyond Rs4 to costa, becoming lighter grey-brown at costa. Fringe dark brown, light grey-brown at tornus, basal area with irregular lighter lime green patch. Costa light grey-brown with 3 dark brown spots from discal to medial area. Ventral surface rust-brown, costa as in dorsal, piliform scales basally. HW dorsal surface brown with pinkish tinge, costa with two grey to yellowish grey spots, margin yellowish brown, fringe dark brown. Tornus margin dark brown. Basal area covered with cream piliform scales. Ventral surface rust-brown, piliform scales basally.

Female genitalia (Figs 23-24). Dorsal plates broad and high, sclerotised, twisted at distal ends, subanal plates short and angular, distinctly wedge-shaped. Antevaginal lamella large, setose in three main patches each connected by a ‘bridge’ of setae, three indentations on posterior margin, central indentation with longer setae. Ductus bursae long and narrow, with diverticulum elongate, ovoid, connected to a broadened section of ductus bursae, end of which attaches to a shorter, rounded tapering corpus bursae.

Variation. In some specimens the green discal and distal areas are not bridged (Fig. 33, left) which, though present very rarely in *A. ligniveren,* appears to always be present in *A. tindalei*. The extent of the green distal area varies somewhat, often reaching the tornus (as in the type), sometimes narrow and reaching only M3. The intensity of green and brown coloration can vary slightly between specimens.

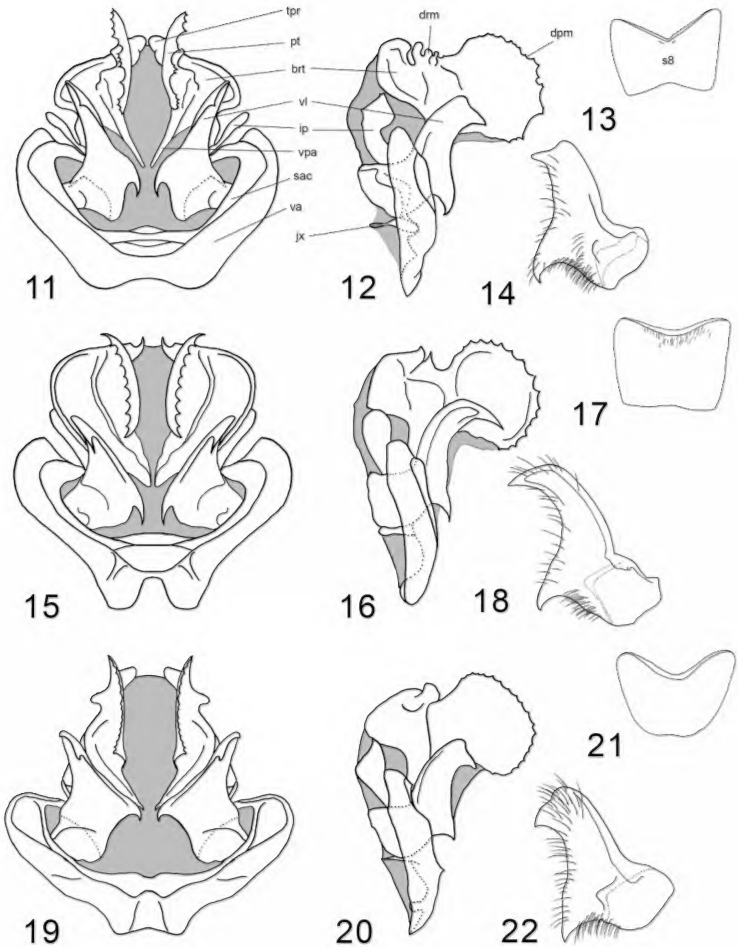


Figs 5-8. Male *Aenetus* spp: (5) *A. moorei* **sp. n.** paratype; (6) *A. tindalei* Simonsen; (7) *A. ligniveren* (Lewin); (8) *A. tindalei* Simonsen, light colour form. (Photos © SAMA).

Figs 9-10. *Aenetus tindalei* Simonsen from the Mount Lofty Ranges: (9) female; (10) male. (Photos © SAMA).

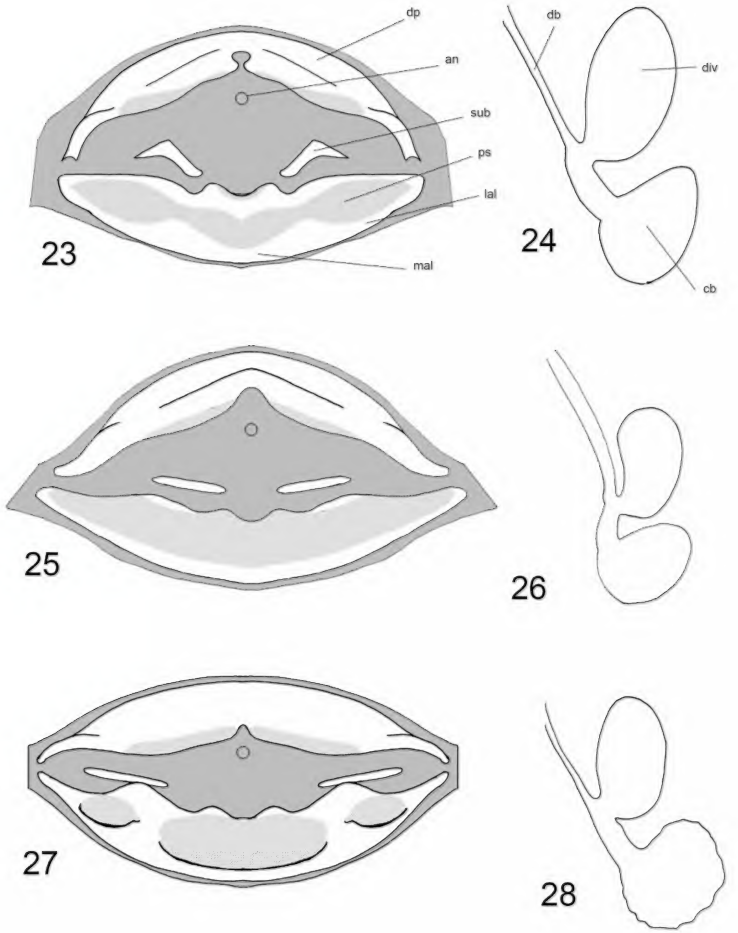
Male (Figs 5, 11-14, 33). Head: Antennae longer than head and slender, filiform, pale brown. Eyes prominent, of roughly same height as head capsule, larger than female, almost meeting dorsally. Scales on frons and vertex dense and white, obscuring base of antennae. Labial palps three segmented, as in female. Thorax: pro- and mesothorax dorsally and ventrally covered in olive green scales and interspersed with lighter green and white scales on ventral surface; band of white scales from base of wing. Legs green, with long white hairs proximally on tibia and tarsus, triangular epiphysis on foretibia; hind leg white with ochreous metatibial tuft of androconial scales. Wings: FW length 23 mm, expanse 49 mm, broad and triangular. Costa slightly concave centrally and convex towards apex. Apex pointed. Wing venation classically hepialine. HW broad, subtriangular, tornus rounded. FW dorsal ground colour uniformly light green with an uneven bright white band along medial line from costa to tornus, where it curves proximally into discal area, forming a basal forewing triangle characteristic of *splendens* group species. A short, narrowly separate basal line is present from dorsum near jugum, extending to CuA2 in the basal area. Costa light green basally, becoming white, with one light green discal spot, followed by a narrower white line not connected with medial line. Ventral surface suffused with light purple scales. HW dorsal surface white, margin at apex light green, margin elsewhere faint bluish green, basal area covered with white piliform scales. Ventral surface as above. Abdomen: long, narrow, white piliform scales basally, green otherwise, with white band on proximal margin of final segment. Green forked tuft of piliform scales at apex. White ventrally. S8 wider than high, with deep, sharply concave posterior and anterior margins.

Male genitalia (Figs 11-14). Basal rim of pseudotegumen broad, rounded, disto- and ventroposterior margins of pseudotegumen rounded, serrate, serrations shorter and more numerous on one lobe and fewer, more widely spaced on opposite. Ventral pseudoteguminal arm membranous. Valvae large, broad at proximal end, with short, blunt sacculus. Viewed postero-ventrally, valvae curve laterally away from pseudotegumen. Tip of valva weakly bipartite, outer tip ending as a squared-off tooth tapering to a sharp point, pointing vertically away from abdomen. When viewed laterally this apical spine is positioned almost horizontally with tip curving slightly downwards. Distal to this spine is a rounded swelling. A large downward-curving hook from distal end of sacculus points vertically downwards and is more curved than apical spine. Fine setae present sparsely between basal hook and tip, with denser patch of hairs between sacculus and hook. Juxta flattened and U-shaped. Truellum membranous. Apodemal vinculum broad and short, with paired posterior projections rounded and smooth. Saccus uniformly triangular, narrow.



Figs 11-22. Aenetus spp. male genitalia: (11-14) *A. moorei* **sp. n.** paratype, EPB Dissection No. EPB-ANIC-4: (11) PVV; (12) LV; (13) S8; (14) vl. (15-18) *A. ligniveren* (Lewin), Brisbane, QLD, EPB Dissection No. 31-016198: (15) PVV; (16) LV; (17) S8; (18) vl. (19-21) *A. tindalei* Simonsen, Gorge Track, SA, EPB Dissection No. 31-020294: (19) PVV; (20) LV; (21) S8. (22) *A. tindalei* vl of specimen from Kelly Hill, KI, SA, EPB Dissection No. EPBKI-1. For abbreviations used herein see 'Methods' section.

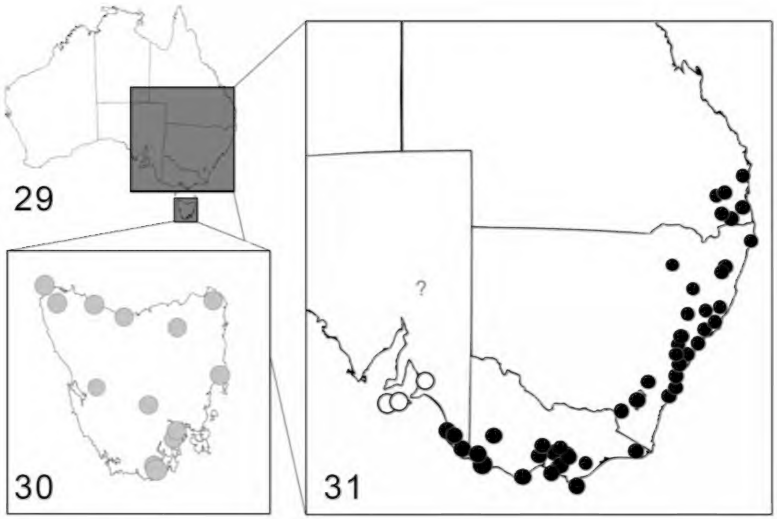
Variation. General forewing colour is sometimes a more muted olive green. Male genitalia vary in number of serrations on pseudotegumen but general structure and proportions remain the same.



Figs 23-28. *Aenetus* spp. female genitalia: (23-24) *A. moorei* **sp. n.** Paratype, EPB Dissection No. 31-016216: (23) PVV; (24) BC. (25-26) *A. ligniveren* (Lewin), Kelso, VIC, EPB Dissection No. 31-016189: (25) PVV, (26) BC. (27-28) *A. tindalei* Simonsen, Gorge Track, SA, EPB Dissection No. EPBMLR-1 (27) PVV; (28) BC, Snake Lagoon KI, Dissection No. EPBKI-2. For abbreviations see 'Methods' section.

Etymology. An eponym in honour of South Australian lepidopterist Michael D. Moore, who has contributed greatly to the conservation of Lepidoptera in SA and to the study of Hepialidae in Australia.

Distribution. Tasmania (Fig. 30), where it is allopatric with the mainland sister-species *Aenetus ligniveren* and *A. tindalei.* Additional localities in Tasmania: Crotty (25 km S of); Devonport; Fernglade Reserve; Ferndene State Reserve (larval bore sighting); Gladstone (1 km SSE of); Hobart; Launceston; Lenah Valley; Woolnorth.



Figs 29-31. Map of Australia showing distribution of *Aenetus* spp: (29) Australia; (30) inset of the main island of Tasmania with *A. moorei* represented by grey circles; (31) inset of southeastern Australia with *A. ligniveren* (Lewin) represented by black circles and *A. tindalei* Simonsen by white circles. The '?' denotes the Flinders Ranges specimen.

Biology. Occurs in temperate rainforest (Fig. 34) and eucalypt wet forest, particularly in riparian situations, where the larvae have been reared from *Acacia dealbata* (Fabaceae), *Eucalyptus regnans* (Myrtaceae), *Nematolepis squamea* (Rutaceae), *Zieria arborescens* (Rutaceae), *Olearia lirata* (Asteraceae) and *Pomaderris apetala* (Rhamnaceae) (Fig. 35). Larvae have been observed in *Melaleuca* and *Leptospermum* (Myrtaceae) and in cultivated *Leptospermum scoparium* in a garden in Wynyard, February 2019 (O. Hill pers. comm.). *Aenetus moorei* occurs at a range of altitudes but is probably absent from the subalpine woodland and alpine areas. Larval tunnel lengths are 54-70 mm (mean of 5 specimens 64.8 mm) and they are made vertically downwards in the stems of saplings and young plants of 15-50 mm diameter, generally 30-200 cm above ground. Larvae were collected at a late instar and reared for 8-9 months before emergence. Full larval development probably takes 2-3 years as discussed in Beaver and Grehan (2018) for similar species.

Pupal duration was 29-32 days (mean 30.2 days) and adult emergence was generally between 1700h and 2100h. Emergence dates for the reared specimens might be an artefact of captive conditions, as the species is generally taken in December and January in nature, based on collection data in TMAG. Specimens were reared in captivity in Adelaide, South Australia, which has a much warmer climate than Tasmania, and this probably influenced emergence time.

Remarks. The major diagnostic differences between the *splendens* group species and in most *Aenetus* are found in females. It is for this reason that I designate an intact female as the holotype for *A. moorei* rather than a male. The neotype for *A. ligniveren,* the lectotype for *A. splendens* and the holotype of *A. tindalei* are also all females.

Figs 32-33. Live habitus images showing natural resting position of adult *Aenetus moorei* **sp. n**. on the night of eclosion: (32) paratype female; (33) paratypes; female left and male right.

The *splendens* group in Tasmania

A reliable way of separating males of the *splendens* group (and *Aenetus* in general) is by comparison of valve morphology (Figs 14, 18, 22), whereby the presence/absence and proportions, as well as shape of hooks, are diagnostic. The apodemal vinculum, S8 and saccus (as seen in Figs 11, 15, 19) are also reliable features to use in species identification, as they differ

markedly between species. The internal and external genitalia of the females of every species are also diagnostic (Figs 23-28) and, due to the confusing overlap in external wing characteristics of female specimens, dissection is the most reliable method of species determination. In particular, the shape of the dorsal plates and the spread of setae on the antevaginal lamellae, as well as the shape of this structure, varies between species, as do the subanal plates, especially with respect to *A. moorei*. In this study, all specimens observed from Tasmania were found to be *A. moorei* and no specimens of *A. ligniveren* were located, suggesting that the two species are allopatric. The Tasmanian locations for '*A. ligniveren*' in Simonsen (2018) are more correctly attributed to this species. *Aenetus moorei* appears to be common in Tasmania, as its larval bores are frequently seen in temperate forests; however, the species is not well represented in collections as the adults appear to come to light infrequently.

Figs 34-35. Habitat of *Aenetus moorei* at Ferndene State Reserve, Tasmania: (34) temperate rainforest understory with larval host *Pomaderris apetala* (Rhamnaceae) at foreground left; (35) close-up of *Pomaderris apetala* with larval bore present, exit hole and callous growth covered by cream-coloured feeding web.

The *splendens* group in South Australia

Aenetus tindalei (Figs 4, 6, 8-10, 19-22, 27-28) was recently described by Simonsen (2018) from Vivonne Bay and also recorded from Kingscote and Penneshaw, Kangaroo Island, SA. It is the most recent addition of *Aenetus* to the SA fauna and the only *Aenetus* species endemic to this State. Historic specimens of a *splendens* group species from mainland SA in the Adelaide/Southern Mount Lofty Ranges (Morialta, Balhanna and Northfield) in SAMA are worn and difficult to work with, confounding identification. This inspired further collecting in this region, leading to the discovery of at least three extant populations: one from Gorge Track, Montacute (Figs 9-10);

one from Belair National Park (a larval bore sighting by EPB); and the third from Cherry Gardens, Scott Creek. Dissection of the Gorge Track specimens (Figs 19-21, 27) confirmed the identification of this population as *A. tindalei* and the author treats the entire Mount Lofty Ranges (MLR) population as this species, after careful examination of the external genitalia and wing morphology of all known specimens from this region. Further specimens for this study were collected from Kangaroo Island (Parndana, Flinders Chase, Karatta, Kelly Hill) and the total number of specimens examined is 35 (21 in SAMA and a further 14 in EPB collection). A surprising level of variation was found in *A. tindalei*, particularly in the female bursae and in the male valve morphology. The bursae in Fig. 28 is from a specimen from Kangaroo Island; however, another two from Gorge Track have the bursa copulatrix identical, although it is curious that the bursae figured by Simonsen (2018) from a KI specimen differs from the example figured here (Fig. 28). The extent of this variation might be due in part to a combination of individual variation and the availability of recently collected material in the present study. The variation in male valvae is less marked but notable, in that those figured here and in Simonsen (2018) appear typical except for one KI individual, where they are much more rounded and are included here for comparison (Fig. 22). This variation was not apparent at the time of description (T. Simonsen pers. comm.); however, it does not appear to have a geographic basis between the MLR/KI regions and does not overlap with variation displayed by *A. ligniveren.* As such, I treat *A. tindalei* as a valid species. The two *A. tindalei* populations are disjunct and are not expected to be interbreeding, as they are separated by approximately 13 km of ocean and are not currently known from the nearby Fleurieu Peninsula. Hepialidae are poor dispersers (Grehan and Mielke 2018) and this geographic separation might be enough to prevent populations from interbreeding at the present time. Kangaroo Island has a long history of separation and reconnection with the mainland (Robinson and Armstrong 1999) and it seems reasonable that in the recent past there were times when the two populations might have been connected and interbreeding. Likely geographic barriers between *Aenetus tindalei* and *A. ligniveren* are the Murray River or the much lower rainfall region comprised of mallee woodlands around the Coorong Area, which lack suitable habitat for either species to occur.

The recent collecting on Kangaroo Island and the MLR region has located *Aenetus tindalei* in riparian vegetation growing along creeks, damp roadside ditches, swamps and coastal woodland vegetation, where larvae have been taken from the stems and branches of *Dodonaea viscosa, Leptospermum continentale, L. myrsinoides, Myoporum viscosum, Acacia provincialis, Acacia paradoxa* (all on KI; EPB unpublished data), *Eucalyptus camaldulensis, Leptospermum* sp. and the introduced weed *Fraxinus angustifolia* at the Gorge Track and Cherry Gardens sites in the MLR region (Beaver and Grehan 2018). Larvae generally construct tunnels 0.5-4 m above

ground, occasionally to 6+ m in *Fraxinus.* Larvae remain in tunnels for 2-3 years before emerging and pupate for around 41-66 days in captivity (Beaver and Grehan 2018). Adults primarily fly from January to February, with some specimens from March and some earlier from December. Emergence is triggered on hot summer nights of rainfall, where the species can emerge *en masse*, particularly reared specimens in captivity. This species appears to be common on the western half of Kangaroo Island; however, the MLR populations are highly localised as habitat here is fragmented and greatly modified by a mix of agricultural and urban land use. The MLR region records in Beaver and Grehan (2018: table 1: 32-36 and fig. 1: F) are labelled incorrectly as *Aenetus ligniveren* and actually refer to *Aenetus tindalei.* A multigene phylogeny is underway for this genus (T.J. Simonsen pers. comm.).

Aenetus ligniveren (Figs 3, 7, 15-18, 25-26) was described by Lewin (1805) from the Sydney area. The type specimen is missing and the problem of its identity was resolved by Simonsen (2018) with the designation of a suitable neotype, a female from Wilton, NSW in ANIC. *Aenetus ligniveren* in SA is known only from the lower south-east of the State, from Mt Gambier, Glencoe, Koorine, Southend, and Kingston SE. Records in Simonsen (2018) show that this population is the western end of a continuous band through Victoria, eastern NSW and southern Qld (Fig. 31, black circles). In SA the species is associated with swamps, riparian vegetation along creeks or coastal vegetation, where larvae have been taken from the stems and branches of *Allocasuarina*, *Melaleuca lanceolata* and *Melaleuca squarrosa* (Beaver and Grehan 2018). These habitats have a long history of clearing and drainage in SA and as a result the species is present only in areas of remnant vegetation where it is uncommonly collected. Interstate, the species often occurs in wet forests and eucalypt tall forest where larvae feed on a wide variety of species from a range of families (Simonsen 2018).

A further *splendens* group specimen is known from Wilpena Pound, Flinders Ranges region of SA (Simonsen 2018); however, without having seen the single male specimen I cannot establish its identity. Simonsen (2018) noted that it was 'near' to *A. tindalei* and I expect it to be *A. tindalei,* particularly now given the known variation in this species and the recognition of its broader than previously recorded distribution. The specimen is apricot yellow in general colour, however yellow forms have been noted in *A. ligniveren, A. splendens, A. astathes, A. tindalei* and in other, non-*splendens* group *Aenetus* species; this feature is therefore not considered significant. Further collecting of *Aenetus* might reveal additional new species, particularly in northern Queensland or the Northern Territory.

Acknowledgments

I would like to thank Marianne Horak, Ted Edwards and You Ning Su (ANIC, Canberra) as well as Simon Grove, Cathy Byrne and Kirrily Moore

(TMAG, Hobart) for loan of specimens, and John Grehan (Museum Witt, Germany), Thomas Simonsen (Aarhus, Denmark), David Lane (Atherton, Qld) and Axel Kallies (University of Melbourne, VIC) for ongoing discussion surrounding *Aenetus*. Also, Peter Hudson and Matthew Shaw and the staff and volunteers of SAMA for access to equipment and specimens, as well as ArtLab Australia for access to photographic equipment. Some specimens were collected under DEW permit no. Y26844-1. I am grateful to Oliver Hill (Burnie, Tas) and Jakob Mitchell (Grange, SA) for accompanying me on collecting trips in both South Australia and Tasmania in 2017-2019, and to my parents Chris and Glenn for assisting me financially with travelling to Tasmania. I would like to thank Kristen Messenger (Adelaide, SA) for rearing larval specimens while I was away collecting, and Blake Gowing (Adelaide, SA) for helpful editing of the manuscript, as well as Joseph Schubert (Museum Victoria, VIC) and Nick Volpe (Darwin, NT) for critique, and Aden Beaver (Adelaide, SA) for assisting greatly with formatting and editing the figures. I am very grateful for the useful critique provided by four reviewers.

References

BEAVER, E.P. and GREHAN, J.R. 2018. A simple rearing technique for larvae and observations on the larval biology of Australian 'splendid ghost moths', *Aenetus* (Herrich-Schäffer, 1855) (Lepidoptera: Hepialidae). *Journal of Insect Biodiversity* **8**(3): 43-51.

GREHAN, J.R. and MIELKE, C.G.C. 2018. Evolutionary biogeography and tectonic history of the ghost moth families Hepialidae, Mnesarchaeidae, and Palaeosetidae in the Southwest Pacific (Lepidoptera: Exoporia). *Zootaxa* **4415**(2): 243-275.

LEWIN, J.W. 1805. *Prodromus entomology. Natural history of lepidopterous insects of New South Wales*. Thomas Lewin: London; pl. 16, p. 17.

SIMONSEN, T.J. 2018. *Monographs on Australian Lepidoptera. Volume 12: Splendid ghost moths and their allies: a revision of Australian Abantiades, Oncopera, Aenetus, Archaeoaenetus and Zelotypia (Hepialidae),* CSIRO Publishing; 312 pp.

ROBINSON, A.C. and ARMSTRONG, D.M. 1999. *A biological survey of Kangaroo Island, South Australia, 1989 and 1990.* Heritage and Biodiversity Section, Department for Environment, Heritage and Aboriginal Affairs, South Australia; 362 pp.

A NEW COMBINATION FOR THE NEW GUINEAN MOTH *EUPROCTIS VIRGINEA* BETHUNE-BAKER, 1904 (LEPIDOPTERA: EREBIDAE: LYMANTRIINAE)

A.P. MACKEY

PO Box 404, Yandina, Qld 4561

Abstract

The New Guinean moth *Euproctis virginea* Bethune-Baker, 1904 is found to be a member of the tribe Leucomini on the basis of features of the genitalia and is transferred to the genus *Leucoma* Hübner, 1822 as *Leucoma virginea* (Bethune-Baker, 1904), **comb. n.** The presence of orange, spatulate setae on the papillae anales of the female is considered a possible apomorphy for the Leucomini.

Introduction

Euproctis virginea Bethune-Baker, 1904 is a large, white Lymantriine with pale blue markings on the forewing, orange coloration on the frons, palpi and legs and a robust body. It was described from material taken at Ekeikei and the Aroa River (Papua New Guinea) but is also found in Indonesian Papua and West Papua (Fig. 1). A recent re-examination of specimens of this species showed it to be wrongly placed in *Euproctis* Hübner, [1819] 1816 (tribe Nygmiini) and that it is a member of the tribe Leucomini. It is consequently transferred to the genus *Leucoma* Hübner, 1822. The male and female genitalia are described for the first time.

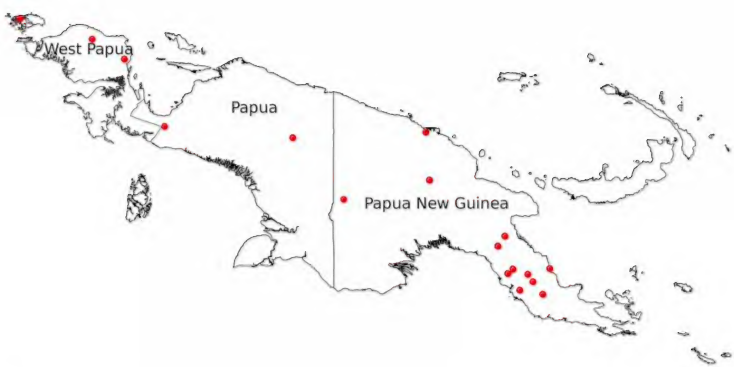


Fig. 1. Known distribution of *Leucoma virginea*.

Purely or predominantly white species are not uncommon in the Lymantriinae, being mostly found among the Leucomini and Arctornithini. They are found also in the Nygmiini, the tribe to which *Euproctis* belongs, but here white species are common in genera such as *Orvasca* Walker, 1865 and *Somena* Walker, 1856, which are generally small, rather gracile species. In fact, *Euproctis virginea* is the only large, robust, white species found in the

New Guinea Nygmiini. Blue is an extremely rare colour in Lymantriinae and in the New Guinea species is known only in *E. virginea* and an undescribed pale blue and blackish brown member of the Leucomini, which might be a form of *Leucoma sericea avolaensis* (Bethune-Baker, 1916). Pale orange or ochreous colouring on the head and legs is a feature of the Leucomini (Holloway 1999) and large, robust *Leucoma* species are known from New Guinea (Mackey 2016). These factors together prompted a review of the placement of *E. virginea.* Examination of the male genitalia showed that they were strongly asymmetric, a feature of the genus *Leucoma* and the Leucomini in general (Holloway 1999) but largely unknown in the Nygmiini. Examination of the female genitalia showed the presence of orange spatulate setae on the lower, internal margin and face of the papillae anales, which might be an apomorphy for the Leucomini as they are known in the type species of the genus, *Leucoma salicis* (Linnaeus, 1758) (Maes 1984), New Guinea species of *Leucoma* (Mackey 2016), *Dendrophleps lobipennis* (Swinhoe, 1892) (Mackey in press) and all members of the genus *Euzora* Turner, 1915 (Mackey in prep.), all of which are members of the Leucomini. On the basis of these factors, *E. virginea* is transferred to the genus *Leucoma*.

Abbreviations: ANIC – Australian National Insect Collection, Canberra, Australia; APM – Research collection of A.P. Mackey, Yandina, Australia; AUM – Australian Museum, Sydney, Australia; BMAG – Birmingham Museum and Art Gallery, Birmingham, United Kindom; KSP – Koleksi Serangga Papua, Universitas Cenderawasih, Waena, Papua, Indonesia; NHM – Natural History Museum, London, United Kingdom; UCD – University of California at Davis, Davis, United States of America.

Leucoma virginea (Bethune-Baker, 1904), comb. n.

(Figs 2-7)

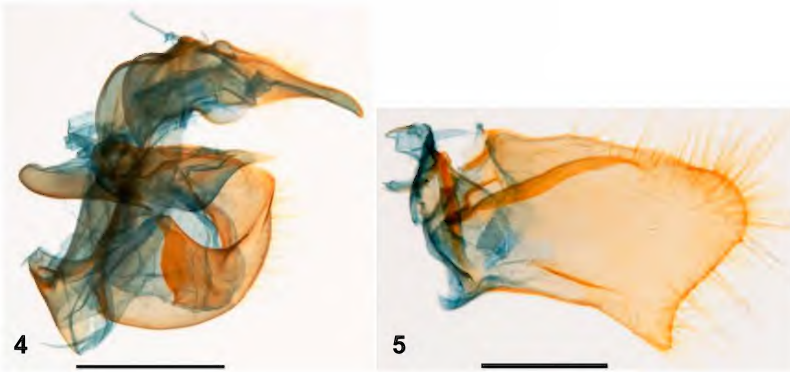
Type material examined. *Holotype*: ♂, Ekeikei, BC New Guinea, 1500 ft., January – April 1903, A.E. Pratt Coll. [NHM].

Other material examined. PAPUA NEW GUINEA: 1 ♂, Ivimka Research Station, Gulf Province, Lakekamu Basin, 120 m, 3-15.xi.1999, T. Sears, G303; 1 ♂, Ivimka Research Station, Gulf Province, Lakekamu Basin, 120 m, 3-15.xi.1999, T. Sears [UCD]; 1 ♀, Amazon Bay area, Deria 700 ft., 11.xii.1962-0.i.1963, W.W. Brandt, ANIC Genitalia No.: 20066; 1 ♂, Jimi River, Western Highlands, 4700 ft, 16.vii-21.ix.1961, W.W. Brandt [ANIC]; 1 ♀, Bagi (Gavien), 50 m, East Sepik District, 3.vii.1975, A.P. Mackey, G957; 1 ♂, Field Sation, Wau, Kuiper Range, Morobe Province, 9-14.iv.2004, M. Schaarschmidt, G1091; 1 ♂, Kiunga, Western District, 1.viii.1975, A.P. Mackey [APM]; 1 ♀, Brown River [Central Province], 24.iv.1966, R. Carver [AUM]; 1 ♂, Ekeikei, 1,500 ft, March-April 1903, A. E. Pratt Coll. [NHM]. INDONESIA (PAPUA): 1 ♂, Walmak, 1600 m, 4°07'S, 139°38'E, Jayawijaya Mountains, Henk van Mastrigt, KSP27847 [KSP]. INDONESIA (WEST PAPUA): 1 ♀, Arfak Mountains, 6,000 ft., March 1910, C.B. & B. Pratt [BMAG]; 1 ♂, Senopi, Tamrau Plateau, 476 m, 0°50'S, 132°55'E, 9.xi.2014, S.G. Sinnema (field record with picture).

Figs 2-3. *Leucoma virginea* males: (2) Jimi River, Western Highlands, New Guinea, 4700 ft, 16.vii-21.ix.1961, W.W. Brandt (scale bar 5 mm); (3) habitus, Indonesia, Papua Barat, Senopi, Tamrau Plateau, 476 m, 0°50'S - 132°55'E, 9.xi.2014, photo: S.G. Sinnema.

Diagnosis. The blueish markings in the forewing distinguish *L. virginea* from all other Leucomini and all other Lymantriinae found in New Guinea.

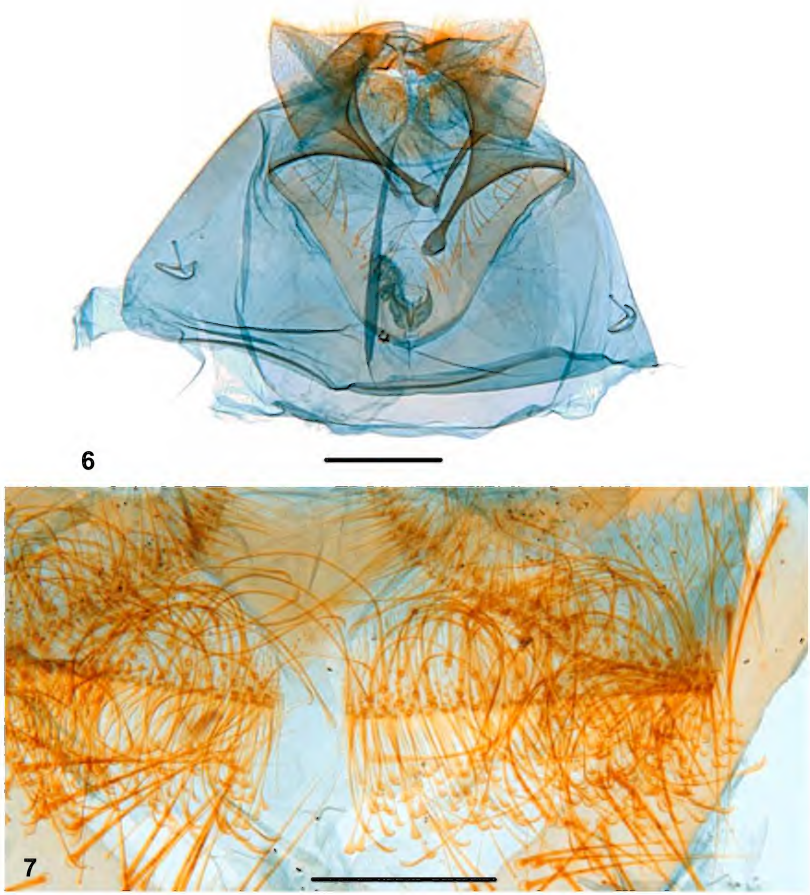
Description. Wings white on both surfaces; forewing upper surface with postmedial line of pale greyish blue spots between CuA1 and 1A+2A, termen with a series of similarly coloured interneural blotches, fringes greyish blue; head and palpi white marked with a variable amount of yellowish orange, legs yellowish orange; thorax with tegulae and patagia thickly streaked with greyish blue, meso- and metathorax with a thick, anteriorly pointing arrow-shaped shaft that can extend to tergite 1 of the abdomen (Figs 2-3). Sexes similar in markings but female slightly larger. Specimens in collections can have the thorax, abdomen and forewing costa heavily stained with brownish orange, but this is absent in fresh specimens.



Figs 4-5. *Leucoma virginea,* male genitalia: (4) lateral view with left valve removed (scale bar 1 mm); (5) left valve (scale bar 0.5 mm).

Genitalia. Male (Figs 4-5). Tegumen and vinculum fused, tegumen a broad band the dorsal part of which curves posteriorly to give a deep emargination on the anterior margin and rather bulbous, slightly expanded shoulders, vinculum also a broad band running vertically, ventrally slightly expanded to form a short, broadly and bluntly rounded, slightly asymmetric saccus; uncus a strong, flat, acutely pointed beak, basally with broad shoulders covered with many long, fine setae, slightly asymmetric with right shoulder slightly larger than left; valvae strongly asymmetric; right valva large, complex, deep proximally, slightly inflated, outward face circular in lateral view and sparsely covered with long fine setae, distally costa deeply and broadly excavated, valve narrowing to a long narrow incurving lobe with a heavily sclerotised chisel-shaped apex, distal margin of valve folded back on itself for a short distance, its ventral corner with a short spur, the left valve much smaller than right, subrectangular, cucullus broadly rounded, covered with long fine setae, terminal edge with a broad, shallow emargination, valvula inwardly curving and slightly inturned, ventral corner acute; juxta a well sclerotised ring; phallus straight, robust, coecum long, rounded, orifice shallowly oblique, vesica without ornamentation.

Female (Figs 6-7). Papillae anales short, broad flimsy and very weakly sclerotised, covered with long orange setae, setae on ventral margin spatulate, apophyses posteriores short, narrow, tapering; segment VIII a narrow band, mid-dorsally membranous, ventrally V-shaped, bearing a series of long, robust orange setae, broadening in the mid-line with a median semicircular notch in posterior margin marking the opening to the sinus vaginalis, apophyses anteriores short, broad, with apex broadly flattened; ductus bursae short, thinly membranous, reflexed slightly to the left; corpus bursae thinly membranous, subspherical, signum absent.



Figs 6-7. *Leucoma virginea,* female genitalia: (6) ventral view (scale bar 1 mm); (7) orange spatulate setae on the papilla analis (scale bar 0.5 mm).

Comments

Holloway (1999), in discussing the definition of *Leucoma*, indicated that it might well be paraphyletic, as it is not based on well defined features. The only common feature of the male genitalia appears to be their asymmetry and this is of tribal rather than generic importance. This lack of generic features might also be true for the females, although their genitalia are not as well known as those of the males. The female genitalia of *L. salicis* possess pseudopapillae, although these are not found in the known females of the Australian and New Guinea species, including *L. virginea* (Mackey in prep., Mackey 2016). Further work on the genus and the Leucomini in general might result in the placement of *L. virginea* in another genus, but the characters discussed above indicate it to be firmly placed within the Leucomini and should certainly be removed from *Euproctis*.

Acknowledgements

I thank staff at the Australian National Insect Collection, the Australian Museum, the Natural History Museum (London), the Birmingham Museum and Art Gallery and the University of California at Davis for access to specimens in their care. Rob de Vos kindly provided the photograph, taken in the field, of a male *L. virginea* at rest, for which I am most grateful. I especially thank You Ning Su (ANIC) for allowing use of a photomicroscope and its software and instructing me in their use.

References

BETHUNE-BAKER, G.T. 1904. New Lepidoptera from British New Guinea. *Novitates Zoologicae* **11**: 367-429.

BETHUNE-BAKER, G.T. 1916. Descriptions of new species of Lepidoptera. *Annals and Magazine of Natural History* (Series 8) **17**(101): 378-385.

HOLLOWAY, J. D. 1999. The moths of Borneo. Part 5. Family Lymantriidae. *Malayan Nature Journal* **53**: 1-188.

MACKEY, A.P. 2016. Two new species of *Leucoma* Hübner, 1822 (Lepidoptera, Erebidae: Lymantriinae) from Papua Indonesia. *Suara Serangga Papua* (SUGAPA digital) **10**(1): 8-12 (*www.sugapa.org*).

MACKEY, A.P. In press. A note on *Dendrophleps lobipennis* (Swinhoe, 1892) (Lepidoptera, Erebidae: Lymantriinae) with a description of the female. *Suara Serangga Papua* (SUGAPA digital) (*www.sugapa.org*).

MAES, K. 1984. A comparative study of the genitalia of some Lymantriidae Hampson, [1893] of the Palaearctic Region. *Mededelingen van de Koninklijke Academie voor Wetenschappen België* **46**: 125-149.

AUSTROPHYA MONTEITHORUM SP. NOV., A NEW DRAGONFLY (ODONATA: ANISOPTERA, LIBELLULOIDEA) FROM TROPICAL QUEENSLAND, AUSTRALIA, WITH NOTES ON ITS COLLECTION AND LOCALITY

GUNTHER THEISCHINGER

Australian Museum, Entomology, 6 College Street, Sydney, NSW 2010

(*E-mail: theischingergunther@gmail.com*)

Abstract

Austrophya monteithorum **sp. n.** is described from a larva collected on the summit plateau of Thornton Peak in tropical Queensland, Australia. The species is compared with *Austrophya mystica* Tillyard (type species of the hitherto monotypic genus) and with larvae of other related genera. Details are given of the type locality, which is difficult to access, and of collections that have been made there.

Introduction

Almost 35 years ago Geoff Monteith gave me a vial containing two interesting dragonfly larvae collected by Sybil Monteith and himself in 1984 from the summit of Thornton Peak, a spectacular locality in tropical Queensland that was then, and is still, difficult to access (see under Habitat). They were preserved in ethanol. Whereas the larger larva was included in the larval description of *Austrophlebia subcostalis* Theischinger (Theischinger 1996), the second larva was only much later assessed as belonging in a possible new genus, listed in Theischinger (2001) as '*L*' and regarded as close to *Austrophya* Tillyard, 1909.

Since 1984, I have visited tropical Queensland and collected there many times but was unable to reach Thornton Peak or to find elsewhere adults that could possibly be associated with the smaller larva. Other Australian and experienced overseas collectors and, more recently, an ever-increasing number of digital photographers, have similarly failed in this quest.

As the species is considered of significance for classification, zoogeography, biodiversity and conservation, it is formally described here as new from the available unique larva. It is hoped that this will encourage searches for the adult and make this a primary target for collectors.

Material and methods

The holotype, an early instar larva preserved in 80% ethanol, is lodged in the Queensland Museum (QM), Brisbane. All other material studied or illustrated is lodged in QM or in the Australian Museum (AM), Sydney. The line drawings were done using a camera lucida and are not to scale.

Austrophya monteithorum sp. n.

(Figs 1-9, 15)

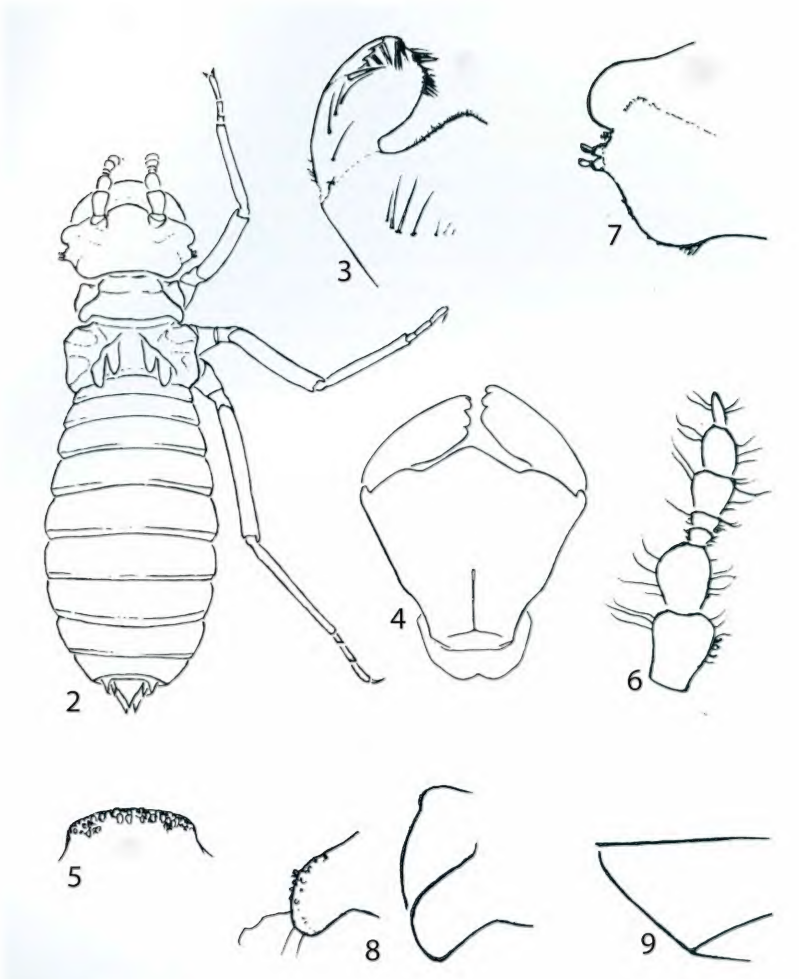
Genus '*L*' species '*m*': Theischinger, 2001: 76.

?Austrophya sp: Theischinger & Endersby, 2014: 104.

Fig. 1. *Austrophya monteithorum* **sp. n.**, early instar larva, with inset *Austrocordulia refracta jurzitzai* Theischinger larva of same length and instar, meaning linear adult measurements *ca* 20% larger than in *A. mystica* Tillyard. Photos by John Martin.

Type material. Holotype larva, AUSTRALIA: Queensland, Thornton Peak [16.164ºS, 145.370ºE], 1100-1300 m, via Daintree, 24-27 Sept. 1984, G.B. and S.R. Monteith. In QM (Reg. No. QMT244915).

Description. From an early instar larva (Figs 1, 2-9) (total length *ca* 9.5 mm). Prementum trapezoidal, scarcely wider than long, distally more than twice as wide as at base; distal border (ligula) distinctly produced medially; 4 pairs of primary, 2-3 pairs of secondary premental setae (Figs 3-4). Labial palp with 7 crenulations; movable hook small, hardly bowed; 4 palpal setae (Figs 3-4). Frontal plate small, with anterior margin evenly convex, beset with very small scales, particularly along anterior margin (Fig. 5). Antennae very hairy, 7-segmented; scape and pedicel large, irregularly oval; segment 3 very small, segment 4 larger than segment 3 but smaller than segment 5, and segment 5



Figs 2-9. *Austrophya monteithorum* **sp. n.**, early instar larva: (2) habitus, dorsal; (3) left labial palp and part of prementum, dorsal; (4) prementum plus labial palps, ventral; (5) median portion of frontal plate, dorsal; (6) antenna; (7) left eye and postocular lobe, dorsal; (8) left pronotal lobe and left lateral portion of prothorax, dorsal; (9) left side of abdominal segment 9, dorsal. Figs as in Theischinger (2001).

smaller than segment 6; segments 3, 4 and 5 subtrapezoidal; segment 6 oval; segment 7 short, finger-like (Fig. 6). Postocular lobes rounded and with two strongly developed lateral tubercles, each with a scale-like seta at apex (Fig. 7). Pronotal lobes rounded, prominent, scaly, somewhat backwardly directed

(Fig. 8). Synthorax slightly wider than head. Wing-pads reaching to middle of abdominal segment 1, indicating a relatively immature larva. The size of the early instar larva suggests a large size for the final instar larva (and the adult). Abdomen ovoid, segments 5 and 6 widest; tergites uniformly arched transversely; no indication of lateral spines; posterior margin of tergite 9 slightly concave (Fig. 9).

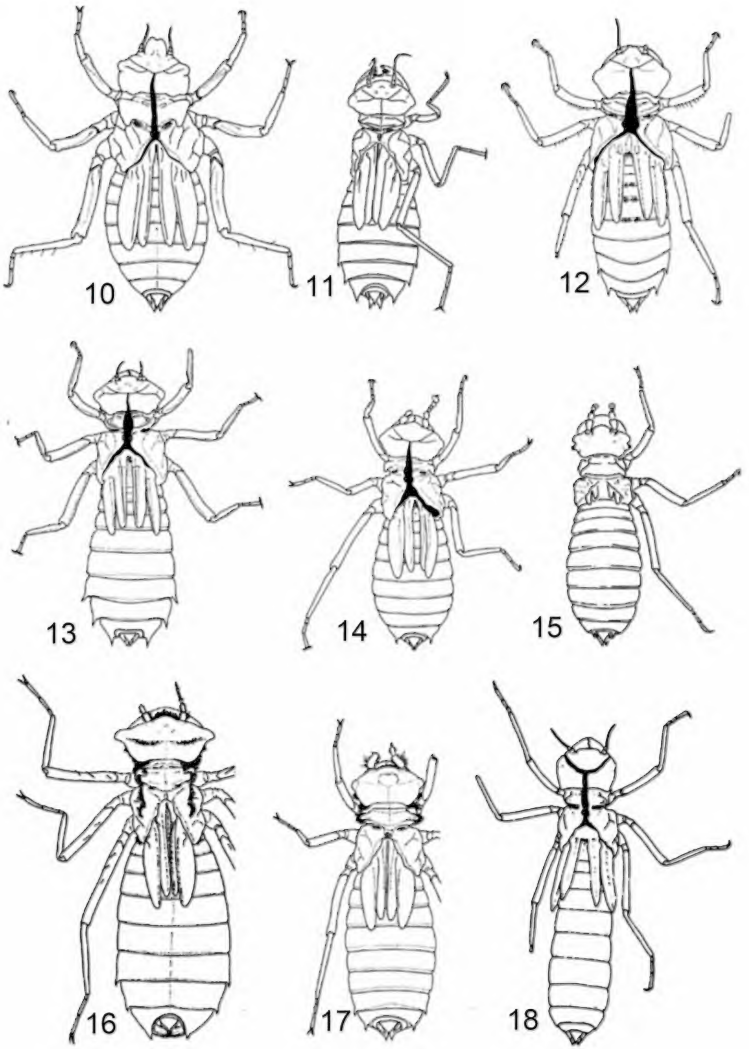
Etymology. It is an absolute pleasure to dedicate this species to its collectors Geoff and Sybil Monteith, both then of the Queensland Museum. The specific name is the masculine form of the genitive case plural of the Latinized family name Monteith.

Discussion

Austrophya Tillyard is a member of the GSI clade (*Gomphomacromia, Synthemis, Idionyx*), the name given to a monophyletic clade of the higher Libelluloidea, established mainly on the basis of molecular studies (Ware *et al.* 2007). This clade is considered the sister taxon to the remaining Corduliidae and Libellulidae. The Australian component of GSI, minus Synthemistidae, includes the genera *Apocordulia* Watson, *Archaeophya* Fraser, *Austrocordulia* Tillyard, *Austrophya* Tillyard, *Cordulephya* Tillyard, *Hesperocordulia* Tillyard, *Lathrocordulia* Tillyard, *Micromidia* Fraser and *Pseudocordulia* Tillyard (Theischinger 2010). Before recognition of GSI all these genera had been classified as Corduliidae, while some were combined and regarded as corduliid subfamilies or even as families of their own. As a temporary solution to these classification difficulties, these and numerous other exterritorial genera were, in the World systematic consensus of Dijkstra *et al.* (2013), listed as (libelluloid) genera *incertae sedis.* This treatment was followed by Theischinger and Endersby (2014), who illustrated the larvae of all Australian genera involved (Figs 10-18).

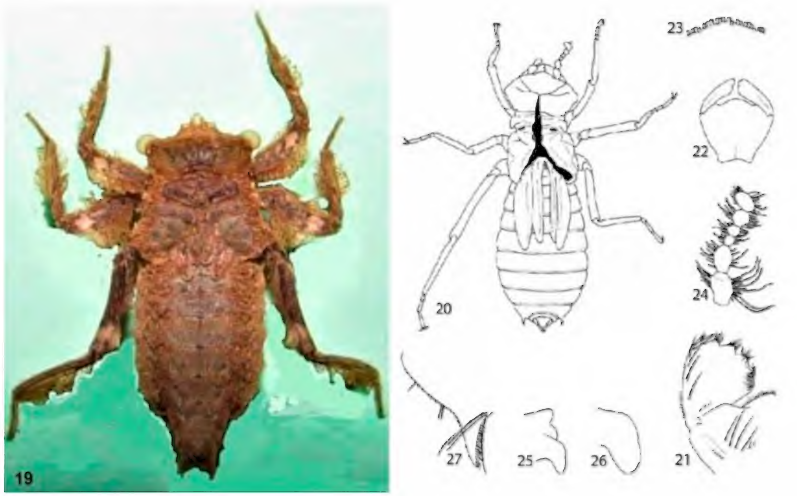
There are apparent similarities of *Austrophya* (including both *A. mystica* (Fig. 14) and *A. monteithorum* (Fig. 15)) in the shape and size of the basal antennal segments and in the strong development of the pronotal lobe with, for example, *Lathrocordulia* (Fig. 17), but definitely not with some other libelluloid genera *incertae sedis*, such as *Archaeophya* (Fig. 10), *Cordulephya* (Fig. 11) and *Pseudocordulia* (Fig. 19).

Based on the available morphological evidence, including possible synapomorphies, *A. monteithorum* **sp. n.** (Figs 1-9, 15) is considered sister to *A. mystica* Tillyard (Figs 14, 20-27), even though generic distinction might be required when the adult of the new species is discovered. Among all libelluloid genera *incertae sedis*, in fact among all Australian Odonata, only these two taxa closely agree in the combination of shape and setation of prementum and labial palps (Figs 2-4, 21-22), antennae with enlarged basal segments and wide, flattened segments 5 and 6 (Figs 6, 24), particular shape of postocular lobe (Figs 7, 20), prominent pronotal lobe (Figs 8, 26) and



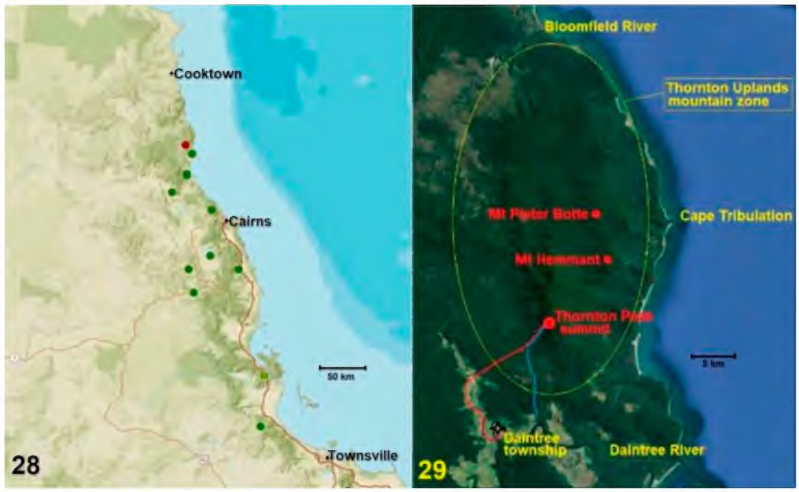
Figs 10-18. Larvae (mostly final instar), all aquatic, or exuviae of Australian Libelluloidea genera *incertae sedis*: (10) *Archaeophya adamsi* Fraser; (11) *Cordulephya pygmaea* Selys; (12) *Apocordulia macrops* Watson; (13) *Austrocordulia leonardi* Theischinger; (14) *Austrophya mystica* Tillyard; (15) *Austrophya monteithorum* **sp. n.**; (16) *Hesperocordulia berthoudi* Tillyard; (17) *Lathrocordulia metallica* Tillyard; (18) *Micromidia convergens* Theischinger and Watson. Figs as in Theischinger and Endersby (2014).

ovoid abdomen with poor development of lateral spines and with slightly concave posterior margin of tergite 10 (Figs 1-2, 9, 20, 27). The new species strongly differs from *A. mystica* in its greater size, indicated by the size (9.5 mm) of the early instar larva (Fig. 1), the laterally distinctively shaped postocular lobe (Fig. 7) and the complete absence of lateral abdominal spines (Figs 1-2, 7). *Austrophya mystica* differs by being markedly smaller in size (indicated by the size of the final instar exuvia at *ca* 13.5 mm), having an only basally distinctly angulate postocular lobe (Fig. 20) and by the presence of a lateral spine on abdominal segment 9 (Figs 20, 27). Other differences between the two species include the shape of the frontal plate, the premental ligula and the pronotal lobe as shown in Figs 3-5, 8 for *A. monteithorum* compared with Figs 20-23, 26 for *A. mystica*.



Figs 19-27. (19**)** *Pseudocordulia* sp., mid-instar larva, 11 mm long, terrestrial, Baldy Mt near Atherton, Qld. Photo: G.B. Monteith. (20-27) *Austrophya mystica* Tillyard, final instar exuvia: (20) habitus, dorsal; (21) left labial palp and part of prementum, dorsal; (22) prementum plus labial palps, ventral; (23) median portion of frontal plate, dorsal; (24) antenna; (25) right lateral portion of prothorax, dorsal; (26) right pronotal lobe, dorsal; (27) left lateral spine of abdominal segment 9, dorsal. Figs as in Theischinger and Watson (1984) and in Theischinger (2001).

It is considered of zoogeographical, biodiversity and conservation significance that *Austrophya monteithorum*, *Austrophya mystica* and one species of *Lathrocordulia* seem restricted to tropical Queensland, whereas the second species of *Lathrocordulia* is confined to the south of Western Australia (Watson *et al.* 1991, Theischinger and Hawking 2006, Theischinger and Endersby 2009, 2014). Known records of *Austrophya monteithorum* and *A. mystica* are shown in Fig. 28.



Figs 28-29. Distribution maps: (28) known records of *Austrophya monteithorum* (red) and *A. mystica* (green) in tropical Queensland; (29) detail of Thornton Uplands mountain zone with major peaks named. Darlington's 1957 route to Thornton summit shown in red; that of Queensland Museum group in 1984 in blue.

The type locality – Thornton Peak

Thornton Peak (*Wundu,* in the language of the Eastern Kuku Yalanji traditional owners) is a granite peak that lies close to the coast just north of the Daintree River, within the Daintree National Park in the northern part of the Wet Tropics World Heritage Area of northern Queensland. This region contains some of the highest mountains in the northern half of Australia and the rainforest-clad Thornton Peak, at 1374 m, is the fourth highest peak in Queensland. It is difficult to access, has an obscure ascent route up the western side and is rarely climbed. Very few entomologists have visited the summit. The first was the noted Harvard biogeographer and carabid specialist, Philip J. Darlington Jnr, during his 18-month collecting trip to Australia in 1956-58 with his wife and 10 year old son (Darlington 1960). He recorded in his unpublished diary, held by the Museum of Comparative Zoology at Harvard that, on December 21, 1957, the three of them waded across the Daintree River with an aboriginal guide who guided them through 8 km of lowland forests to the western base of the mountain (Fig. 29). They camped in a clearing there and next day *'we took some light packs with blankets and food for a night on the mountain and went up (I had gone half way up and marked the day before) to the edge of the summit plateau, over 4000', but there we were turned back by heavy rain, wind and clouds. We did some collecting and got at least a sample of the carabid fauna but nothing like a good collection.'*

The only subsequent insect collections on Thornton summit have been by parties from the Queensland Museum led by G.B. Monteith in 1981, 1983 and 1984, the last of which captured the dragonfly larva described in this work. In his words: *'I had found Darlington's route and backpacked up and camped on the summit to make insect collections on two occasions before that 1984 trip. The first was in September 1981 with Doug Cook and the second was with Geoff Thompson and David Yeates in October 1983. So I knew how to get there, but it was a long hard hike and we could never take much gear on foot. Then in 1984 I had funds for a helicopter, so I organized a small group of eight keen biologists to join a visit* (Fig. 30). *We drove to as close as we could go at dawn on Sept. 24 and the helicopter met us there. The pilot expected to take about 3-4 lifts to get us all up to the summit. He did not know where to land at the summit, but I did, so on the first lift he took just me and some of the gear. When he tried to fly up the slopes of the mountain we found that near the top, the downdraft of the SE Trade winds coming off the ocean and down the back of the mountain was too strong for the helicopter to actually fly right to the summit plateau. So we flew down to the western base of the mountain and dumped the gear in a small clearing where Darlington had camped at the base in 1957, then flew 8 km back to the waiting, mystified crew and ferried them all in to that basal clearing. The chopper then flew away and left us. We loaded as much of the gear as we could carry into our packs, left the rest, then hiked all day through the rainforest up 1300 m altitude and got to the top just before dark, exhausted. The absolute summit of Thornton is a pile of giant boulders at 1370 m. Immediately west of the summit is a small flat plateau, a half kilometre in diameter, of moss forest and fern glades at 1200 m almost completely surrounded by boulder piles* (Fig. 31). *That flat plateau is drained by an idyllic, permanently flowing, clear stream* (Fig. 32). *This is the absolute head of Hilda Creek which flows steeply down the western side of the mountain and into the Daintree River. We camped in a tiny clearing right beside that creek and almost all the collecting we did was within about 200 metres of that site. Our campsite is at exactly 16.1641°S x 145.3704°E at 1230 m. The place where we left our cars is at 16.231°S x 145.370°E and the place where the chopper dropped our gear is at 16.187°S x 145.355°E. After four nights up there we humped all our gear and collections back to where our cars were at the road, with a lot of scratched and sore legs* (Fig. 29).

Figs 30-32. Thornton Peak: (30) Sept. 1984 collecting party at the summit campsite. Standing, from left: Tony Irvine (botanist from CSIRO), Ray Leggett (volunteer from QM), John Clarkson (botanist from Qld Herbarium), Sybil Monteith (QM Inquiry Centre), Rhonda Scouller (QM Education Officer). Crouching from left: Jeanette Covacevich (QM herpetologist), Steve Wilson (QM herpetologist), Geoff Monteith (QM entomologist). Tony and Jeanette have since died. (31) View across end of summit plateau. Prominent trees are *Gymnostoma australianum* Johnson. (32) Hilda Creek in low rainforest of summit plateau. Photos by Steve Wilson.

30

31

32

Thornton Peak endemicity

Biological surveys and faunistic studies of the Wet Tropics Zone have recognised 17 discrete montane biogeographic units occupying the 500 km between Townsville and Cooktown (Yeates and Monteith 2008). One of these is the Thornton Uplands, a block of habitat lying between the Daintree and Bloomfield rivers, which is centred on Thornton Peak and includes the adjacent, but lower, Mt Hemmant and Mt Pieter-Botte a few kilometres to the north (Fig. 29). The Thornton Uplands was shown to have the fifth highest insect endemicity (20%) of the 17 mountain units (Yeates *et al.* 2002). This endemicity is focussed on Thornton Peak itself with a number of species restricted to its absolute summit zone. Examples include the arboreal carabid beetles *Philipis trunci* (Darlington, 1963), *P. laevis* Baehr, 1995 and *Sitaphe laevis* Baehr, 2003, as well as the blind terrestrial water beetle *Paroster anophthalmus* (Brancucci and Monteith, 1996). A dominant tree on the summit plateau is *Gymnostoma australianum* L.A.S. Johnson (Fig. 31), a relict of a genus from Malesia and Pacific islands, and in Australia found only on Thornton Peak and adjacent Mt Pieter Botte. Among vertebrates, the frog *Cophixalus concinnus* Tyler, 1979 is restricted to Thornton Peak summit and is listed as critically endangered by the IUCN (Hero *et al.* 2004). It was shown to not occur below 1080 m by Hoskins and Higgie (2005), who noted its vulnerability to global warming. It is thus not surprising that a previously unknown odonate might also occur in that unique habitat.

Acknowledgements

I wish to express my gratitude to Geoff Monteith for letting me study his valuable material, for giving precise information on the collecting locality and the account of how he and his party got there, for local faunistic information and for his photograph of a *Pseudocordulia* larva from the QM collection. Thanks also to John Martin for making even the larva of the new species look good. Ian Endersby and Vincent Kalkman supplied distribution records and a dot map and Albert Orr and Vincent improved the manuscript with valuable suggestions. Steve Wilson allowed reproduction of his photographs taken on the expedition where the specimen was collected.

References

BAEHR, M., 1995. Revision of *Philipis* (Coleoptera: Carabidae: Bembidiinae), a genus of arboreal tachyine beetles from the rainforests of eastern Australia. Taxonomy, phylogeny, and biogeography. *Memoirs of the Queensland Museum* **38**: 315-381.

BAEHR, M. 2003. Psydrine ground beetles (Coleoptera: Carabidae: Psydrinae), excluding Amblytelini, of eastern Queensland rainforests. *Memoirs of the Queensland Museum* **49**(1): 65-109.

BRANCUCCI, M. and MONTEITH, G.B. 1996. A second *Terradessus* species from Australia (Coleoptera: Dytiscidae). *Entomologica Basiliencia* **19**: 585-591.

DARLINGTON, P.J. 1960. Australian carabid beetles IV. List of localities, 1956-1858. *Psyche* **67**: 112-126.

DIJKSTRA, K.-D.B., BECHLY, G., BYBEE, S.M., DOW, R.A., DUMONT, H.J., FLECK, G., GARRISON, R.W., HÄMÄLÄINEN, M., KALKMAN, V.J., KARUBE, H., MAY, M.L., ORR, A.G., PAULSON, D.R., REHN, A.C., THEISCHINGER, G., TRUEMAN, J.W.H., VAN TOL, J., VON ELLENRIEDER, N. and WARE, J. 2013. The classification and diversity of dragonflies and damselflies (Insecta: Odonata). *Zootaxa* **3703**(1): 36-45.

HERO, J-M, ALFORD, R., CUNNINGHAM, M., HOSKIN, C. and McDONALD, K. 2004. *Cophixalus concinnus*. The IUCN Red List of Threatened Species [Accessed 15 June 2019]. *http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T41118A10402316.en*

HOSKIN, C.J. and HIGGIE, M. 2005. Minimum calling altitudes of *Cophixalus* frogs on Thornton Peak, north eastern Queensland. *Memoirs of the Queensland Museum* **51**(2): 572.

THEISCHINGER, G. 1996. The species of *Austrophlebia* Tillyard (Odonata: Anisoptera: Aeshnidae: Brachytroninae). *Linzer biologische Beiträge* **28**: 305-314.

THEISCHINGER, G. 2001. *Preliminary keys for the identification of larvae of the Australian Synthemistidae, Gomphomacromiidae, Pseudocorduliidae, Macromiidae and Austrocorduliidae* (*Odonata*). Identification Guide No. 34, Cooperative Research Centre for Freshwater Ecology, Albury, pp i-iv, 1-88.

THEISCHINGER, G. 2010. Der GSI-Clade (Odonata, Libelluloidea) in Australia – Systematik im Fluss. *Entomologica Austriaca* **17**: 49-66.

THEISCHINGER, G. and ENDERSBY, I. 2009. *Identification guide to the Australian Odonata*. Department of Environment, Climate Change & Water NSW, Sydney; 283 pp.

THEISCHINGER, G. and ENDERSBY, I. 2014. Australian dragonfly (Odonata) larvae: descriptive history and identification. *Memoirs of Museum Victoria* **72**: 73-120.

THEISCHINGER, G. and HAWKING, J.H. 2006. *The complete field guide to dragonflies of Australia.* CSIRO Publishing; 366 pp.

THEISCHINGER, G. and WATSON, J.A.L. 1984. Larvae of Australian Gomphomacromiinae and their bearing on the status of the *Synthemis* group of genera (Odonata: Corduliidae). *Australian Journal of Zoology* **32**: 67-95.

WARE, J., MAY, M. and KJER, K. 2007. Phylogeny of the higher Libelluloidea (Anisoptera: Odonata): an exploration of the most speciose superfamily of dragonflies. *Molecular Phylogenetics and Evolution* **45**: 289-310.

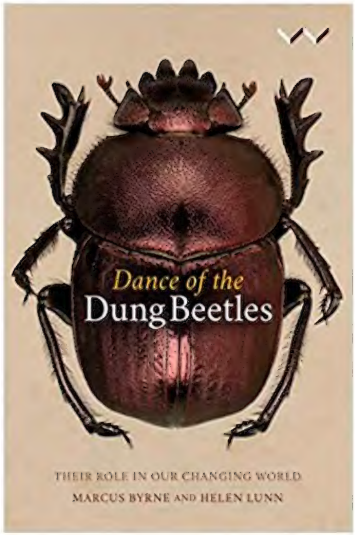
WATSON, T., THEISCHINGER, G. and ABBEY, H. 1991. *The Australian dragonflies. A guide to the identification, distribution and habitats of Australian Odonata*. CSIRO: Canberra and Melbourne.

YEATES, D.K., BOUCHARD, P. and MONTEITH, G.B. 2002. Patterns and levels of endemism in the Australian Wet Tropics rainforests: evidence from flightless insects. *Invertebrate Systematics* **16**: 605-619.

YEATES, D.K. and MONTEITH, G.B. 2008. The invertebrate fauna of the Wet Tropics: diversity, endemism and relationships. Pp 178-190, in: Stork, N. and Turton, S. (eds), *Living in a dynamic tropical forest landscapes*. Wiley-Blackwell, UK; 652 pp.

BOOK REVIEW

Dance of the Dung Beetles: their role in our changing world. By Marcus Byrne and Helen Lunn. Wits University Press, Johannesburg, 2019; xiii + 228 pp. Size 15 x 23 cm. Price US$35.00. EAN: 978-1-77614-234-7 (paperback). Available at: *http://witspress.co.za/catalogue/dance-of-the-dung-beetles/*



Dance of the Dung Beetles is about so much more than dung beetles. The book masterfully weaves the history of natural history, behavioural science, evolution and ecology together with dung beetles as the common thread.

Chapters proceed in a chronological fashion starting with various ancient cultures that revered the dung beetle as a deity. The story continues into the 17th and 18th Centuries with early naturalists, explorers and artists writing the first descriptions of dung beetles and their behaviour. From there the chapters explore the beginnings of natural history museums and scientific nomenclature. Throughout this historical journey, we read how the dung beetle influenced the thinking of people like Aldrovandi, Fabre and Darwin.

As the story moves to more recent times, we learn about the birth of agricultural entomology as a result of the farming explosion in the US during the late 1800s and early 1900s, followed by early biological control experiments. From here the story expounds into the role of introduced dung beetles for pest reduction in Hawai'i and Australia, delving into the amazing variations in dung beetle behaviour that help explain why sometimes the introductions of dung beetles worked or didn't. Dung beetle research and collections greatly expanded with the development of the CSIRO Dung Beetle Research Unit in South Africa under the direction of George Bornemissza. The unit oversaw the collection of thousands of dung beetles from South Africa, Europe and China that resulted in the export of thousands of surface-sterilised dung beetle eggs to Australia.

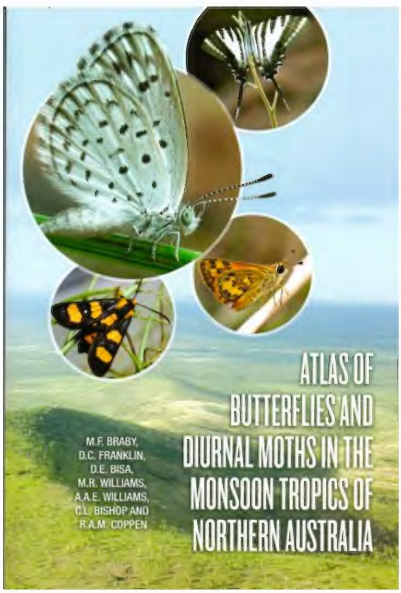
The final chapters explore the latest fascinating research on dung beetles. One section details the experiments undertaken to study dung beetle orientation and navigation using the sun or stars. Dung beetles are also being used to study evolution, development and within-species variation. Current research is just beginning to help us to understand their evolution, their diets and their complex behaviours.

Overall, the book is very enjoyable to read. It includes 36 beautiful colour photos. The text is written for a general science audience, with clear explanations of complex concepts such as evolution, genetics and epigenetics. All is overlaid with a delightful touch of humour. I highly recommend it for anyone with an interest in natural history!

Reviewed by Kathryn Ebert

BOOK REVIEW

Atlas of butterflies and diurnal moths in the monsoon tropics of northern Australia. By M.F. Braby, D.C. Franklin, D.E. Bisa, M.R. Williams, A.A.E. Williams, C.L. Bishop and R.A.M. Coppen. ANU Press, Canberra, 2018; xxxii + 430 pp. Price $135. ISBN 978 1 760462 321 (paperback). ISBN (online): 978 1 760462 338 (free pdf download from *https://press.anu.edu.au/publications/atlas-butterflies-and-diurnal-moths-monsoon-tropics-northern-australia*).



It is a gauge of the maturing state of knowledge of a particular animal group when books treating sub-regional faunas in detail begin to appear. We have already seen several local field guides to butterflies and several moth groups covering limited areas of southern Australia. However the present work, led by Michael Braby, is altogether more ambitious. It is the first attempt to document in detail the poorly known fauna of the vast western part of the Monsoon tropics (excluding Cape York Peninsula). As such it is a remarkable and welcome new addition to the burgeoning Australian literature on Lepidoptera.

The geographical area covered includes all Australian territory between 120°-140°E and 10°-20°S and is divided into four sub-regions: Kimberley, Top End, Western Gulf Country and Northern Deserts. From this area 132 butterfly species are recorded and documented (with *Candalides heathi* added as an addendum), as well as 28 species of day-flying moths. This latter inclusion is particularly welcome because, although they belong to eight taxonomically diverse families, they all share much in common with butterflies in their ecology and behaviour. In particular, many are distasteful to birds and hence are aposematically marked in bright colours. Moreover, they are typically more often encountered by butterfly collectors than by moth collectors, who sample at night using light traps and, in this country, information on their identification and ecology has hitherto been poor.

The book is a scholarly production with well over 300 references. Introductory chapters provide a concise introduction to the biogeography, climatology and ecology of the region, as well as an historical account of past work. There is a clear explanation of the protocol used in producing the Access database used to generate the maps and diagrams, a model that might well be adopted in future studies for other regions of Australia. Two appendices list larval host plants and conservation status evaluation for species with restricted distributions, including several regional endemics. The result is a comprehensive snapshot of our knowledge of this fauna and an invaluable set of baseline data for future ecological studies and conservation planning.

The book is primarily an atlas and at its heart are 23,885 individual records of mostly detailed information on locality, habitat and date of observation for every species. These were obtained using a range of methods, including sight records, museum collections and literature reports. This means that on average there are nearly 150 records for each species (although for some there are fewer and for others many more). These are individually plotted for each species on one large, clear map, with the source of the record encoded by the use of different icons and colour coding indicating whether records are from before or after 1970. In theory this might show shifting trends in distribution but pre-1970 records are so sparse it rather serves to emphasise that much of what is known was elucidated in the last 50 years. Each map also includes distribution points for larval host plants and putative host plants, which as a rule tend to be more extensive than the butterfly/moth records, except in cases such as *Cressida cressida*, a known wanderer, but also a species whose host plant can be extremely difficult to locate. Below this detailed map is a second, simpler one of the same size, with un-coded distribution points and a shaded area indicating the species' distribution within the region covered. As well as the maps, the seasonal abundance of each species is illustrated, as are available seasonal records for all four life stages: egg, larva, pupa and adult. In many cases it is clear from the phenology of the adults that data are missing for many months for various early stages, offering a challenge to field naturalists to fill in the gaps. Facing the maps and diagrams is a succinct one page species account with an illustration of the species and text under the headings: Distribution, Habitat, Larval food plant, Seasonality, Breeding status and Conservation status. Therefore, every species is treated fully in a two page single opening, making the book attractive to the eye and convenient to use in hardcopy.

Although this is first and foremost a practical book, it is no dry monograph. It is lavishly illustrated with spectacular landscape photographs; many effectively illustrate the diversity of habitats within the region but others are purely decorative. Each species is illustrated with at least one photograph of an adult, almost always in life, with only a handful of rarities figured by mounted museum specimens. This lends the book a particular vivacity that marries well with the beautiful habitat shots. It is enjoyable to browse for this reason alone. It should be noted, however, that not all the species photographs are ideal for diagnostic purposes. For example, the *Eurema* species as well as some skippers might be hard to identify from the illustrations provided, but this is not the point. This book is a geographical and ecological atlas and it is assumed most users will be able to identify the species. The photos serve as an *aide de memoire* and, should it be necessary, they can easily be identified using other sources. The exception to this are the day-flying moths, all of which can easily be recognised from the photographs, even if sometimes they cannot be identified beyond genus as no name is available yet.

There is very little in terms of presentation or information to criticise, but I suggest in the treatment of day-flying moths, the family of each species might have been indicated in its heading. At present the families represented are listed under a general heading, but there is no way of knowing to which family a particular species belongs, not even by consulting the main text. As the publisher has made this book available in pdf format, it would be easy to add this information to the species headings, at least to the online version. Otherwise, I warmly congratulate the authors on their landmark achievement and strongly recommend this book, either in hardcopy or pdf format, for anyone with a serious interest in Australian Lepidoptera or the natural history of the 'top end'.

Reviewed by Albert Orr

NEW LITERATURE

BAEHR, M.

2018. The cyclosomine genus *Sarothrocrepis* Chaudoir (Coleoptera: Carabidae: Cyclosomini). *Spixiana* **42**(2): 211-336.

CASSIS, G., SYMONDS, C. and BRANSON, L.

2019. Systematics and species radiation of the sheoak lacebug genus *Epimixia* Kirkaldy (Insecta: Heteroptera: Tineidae) in Australia, New Caledonia and Papua New Guinea. *Invertebrate Systematics* **33**(2): 277-366.

CRAIG, D.A., CURRIE, D.C., GIL-AZEVEDO, L.H. and MOULTON, J.K.

2019. *Austrocnephia*, new genus, for five species of '*Paracnephia*' (Diptera: Simuliidae), with a key to Australian black fly genera. *Zootaxa* **4627**(1): 1-92. (http://dx.doi.org/10.11646/zootaxa.4627.1.1)

CRANSTON, P.S.

2019. *Paraskusella* gen. nov., a new Afro-Australian genus in the tribe Chironomini (Diptera: Chironomidae). *Austral Entomology* **58**(2): 268-281.

2019. *Riethia* (Kieffer 1917) (Diptera: Chironomidae) revised for the Austro-Pacific region, *Zootaxa* **4646**(3): 461-500. (http://dx.doi.org/10.11646/zootaxa.4646.3.3)

EBERT, K.M., MONTEITH, G.B., MENÉNDEZ, R. and MERRITT, D.J.

2019. Bait preferences of Australian dung beetles (Coleoptera: Scarabaeidae) in tropical and subtropical Queensland forests. *Austral Entomology* doi: 10.1111/aen.12396

EVANS, M.L., EGAN, S., IRWIN, P.J. and OSKAM, C.L.

2019. Automatic barcode gap discovery reveals large COI intraspecific divergence in Australian Ixodidae. *Zootaxa* **4656**(2): 393-396. (http://dx.doi.org/10.11646/zootaxa.4656.2.13)

FERGUSON, D.J. and YEATES, D.K.

2019. Immature stages of two Australian mydas flies (Diptera: Mydidae) of the genera *Diochlistus* and *Miltinus. Austral Entomology* **58**(2): 409-417.

FERGUSON, D.J., GLATZ, R.V. and YEATES, D.K.

2019. New stiletto flies in the genus *Anabarhynchus* Macquart (Diptera: Therevidae) from Kangaroo Island, South Australia. *Zootaxa* **4646**(2): 331-345. (http://dx.doi.org/10.11646/zootaxa.4646.2.8)

KOLESIK, P., BUTTERWORTH, N., LEMMON, J., GIBSON, T. and WALLMAN, J.

2019. First gall midge (Diptera: Cecidomyiidae) known to feed on plant family Atherospermataceae: a new species of *Asphondylia* damaging the endangered Australian tree *Daphnandra johnsonii. Austral Entomology* **58**(2): 317-323.

LAHEY Z., MASNER L. and JOHNSON, N.F.

2019. *Calixomeria*, a new genus of Sceliotrachelinae (Hymenoptera, Platygastridae) from Australia. *ZooKeys* **830**: 63-73. (https://doi.org/10.3897/zookeys.830.32463)

LAMBKIN, K.J.

2019. Revision of *Mesothymbris* Evans, 1956, from the Late Triassic of Mount Crosby, Queensland (Hemiptera: Cicadomorpha: Hylicelloidea: Hylicellidae). *Zootaxa* **4629**(3): 389-396. (http://dx.doi.org/10.11646/zootaxa.4629.3.6)

LANGILLE, B.L., TIERNEY, S.M., AUSTIN, A.D., HUMPHREYS, W.F. and COOPER, S.J.B.

2019. How blind are they? Phototactic responses in stygobiont diving beetles (Coleoptera: Dytiscidae) from calcrete aquifers of Western Australia. *Austral Entomology* **58**(2): 425-431.

LAWRENCE, J.F.

2019. Australian Nitidulinae: general review with descriptions of new genera and species (Coleoptera: Nitidulidae). *Zootaxa* **4657**(2): 261-290. (http://dx.doi.org/10.11646/zootaxa.4657.2.3)

LI, X. and YEATES, D.K.

2018. Phylogeny and taxonomic revision of the genus *Eristalopsis* Evenhuis (Diptera: Bombyliidae: Bombyliinae). *Arthropod Systematics and Phylogeny* **76**(3): 395-427.

MESIBOV, R.

2019. A new and cryptic species of *Lissodesmus* Chamberlin, 1920 (Diplopoda, Polydesmida, Dalodesmidae) from Tasmania, Australia. *ZooKeys* **846**: 31-41. (https://doi.org/10.3897/zookeys.846.35028)

STEINBAUER, M.J.

2019. Wing pattern polyphenism in two behavioural forms of *Ochrogaster lunifer* (Lepidoptera: Notodontidae). *Austral Entomology* **58**(2): 432-442.

TAYLOR, C.K., MURPHY, M.V., HITCHEN, Y. and BROTHERS, D.J.

2019. Four new species of Australian velvet ants (Hymenoptera: Mutillidae, Aglaotilla) reared from bee and wasp nests, with a review of Australian mutillid host records. *Zootaxa* **4609**(2): 201-224. (http://dx.doi.org/10.11646/zootaxa.4609.2.1)

VEENSTRA, A.K., LEBE, T., MILNE, J. and KOLESIK, P.

2019. Two new species of *Dactylasioptera* (Diptera: Cecidomyiidae) inducing stem galls on *Maireana* (Chenopodiaceae). *Austral Entomology* **58**(1): 220-234.

WILLIAMS, A.E., COPPEN, R.A.M. and WILLIAMS, M.R.

2018. A method for conducting mark-release-recapture studies on the graceful sun-moth, *Synemon gratiosa* (Lepidoptera: Castniidae). *Records of the Western Australian Museum* **33**(2): 181-186.

WILLIAMS, G.

2019. Insects associated with flowering of *Rhodomyrtus psidioides* (Myrtaceae): is this a myrtle rust (*Austropuccinia psidii*)-induced plant-pollinator interaction extinction event? *Cunninghamia* **18**: 23-27. (doi:7751/cunninghamia.2018.002)

WILLIAMS, G. and ADAM, P.

2019. A preliminary checklist of flower-visiting insects from *Syzygium floribundum*, *Syzygium smithii* and *Tristaniopsis laurina*: three members of the myrtle rust-vulnerable plant family Myrtaceae. *Cunninghamia* **19**: 57-74. (doi:10.7751/cunninghamia.2019.19.005)

WILSON, J.D., RIX, M.G., RAVEN, R.J., SCHMIDT, D.J. and HUGHES, J.M.

2019. Systematics of the palisade trapdoor spiders (*Euoplos*) of south-eastern Queensland (Araneae: Mygalomorphae: Idiopidae): four new species distinguished by their burrow architecture. *Invertebrate Systematics* **33**(2): 253-276.

ŻABKA, M., PATOLETA, B. and TRĘBICKI, L.

2019. Salticidae (Arachnida: Araneae) inhabiting islands off Australia re-visited. *Austral Entomology* **58**(2): 382-386.

THE AUSTRALIAN ENTOMOLOGIST
ABN#: 15 875 103 670

The *Australian Entomologist* is a non-profit journal published in four parts annually by the Entomological Society of Queensland and is devoted to entomology of the Australian region, including New Zealand, New Guinea and islands of the south-western Pacific. The journal is produced independently and subscription to the journal is not included with membership of the society.

The Publications Committee

Editor:	Dr D.L. Hancock
Assistant Editors:	Dr G.B. Monteith, Dr F. Turco, Dr L. Popple, Ms S. Close.
Business Manager:	Dr G.B. Monteith (geoff.monteith@bigpond.com)

Subscriptions

Subscriptions are payable in advance to the Business Manager, The Australian Entomologist, P.O. Box 537, Indooroopilly, Qld, Australia, 4068.

For individuals:	A$33.00 per annum in Australia.
	A$60.00 per annum in Asia-Pacific Region.
	A$65.00 per annum elsewhere.
For institutions:	A$37.00 per annum in Australia.
	A$65.00 per annum in Asia-Pacific Region.
	A$70.00 per annum elsewhere.

Electronic Subscriptions: A$25 individuals, A$30 institutions.

Please forward all overseas cheques/bank drafts in Australian currency.
GST is not payable on our publication.

ENTOMOLOGICAL SOCIETY OF QUEENSLAND (www.esq.org.au)

Membership is open to anyone interested in Entomology. Meetings are normally held at the Ecosciences Precinct, Dutton Park, at 1.00pm on the second Tuesday of March-June and August-December each year. Meetings are announced in the Society's News Bulletin which also contains reports of meetings, entomological notes, notices of other Society events and information on Members' activities. Enquiries relating to the Society should be sent to the Honorary Secretary, Entomological Society of Queensland, P.O. Box 537, Indooroopilly, Qld, 4068.

COVER

The Richmond Birdwing, *Ornithoptera richmondia* is the smallest member of its genus and the only *Ornithoptera* species found outside the tropics. It is endemic to southern Queensland and northern New South Wales. This female, seen at Mary Cairncross Scenic Reserve in the Sunshine Coast hinterland, is searching for a place to lay its eggs in the forest understory near the entrance to the rainforest walk. It requires soft young growth of the vine *Pararistolochia praevenosa* and is more commonly seen high overhead in the subcanopy. The species is regarded as vulnerable and has been the target of a concerted community based recovery plan now managed by the Queensland Government Department of Environment and Science. Pen and ink drawing by *Australian Entomologist* contributor Dr Albert Orr, an award-winning author of illustrated butterfly and dragonfly books in Australia and overseas.

NOTES FOR AUTHORS

We welcome manuscripts dealing with non-pest aspects of the native insect and arachnid faunas of Australia, New Guinea, New Zealand and islands in the south-western Pacific region. Manuscripts for consideration for publication should be submitted in Microsoft Word. Digital illustrations should be sent initially as low resolution images in a separate Word file, as low resolution JPEGs, or as low resolution PDF files, with figure numbers indicated clearly for each figure. High resolution TIFFs or JPEGs (300 dpi at print size) must be provided at the time of acceptance of the manuscript. Digital manuscripts and illustrations may be sent via email to geoff.monteith@bigpond.com or can be posted on disk or USB to:

The Business Manager,
The Australian Entomologist
P.O. Box 537
Indooroopilly, Qld, 4068

Authors should refer to recent issues for format and style. An example issue is available on the ESQ website at http://www.esq.org.au/pdf/aust_ent_44_3.pdf

All papers will be forwarded to two referees and the editor reserves the right to reject any paper considered unsuitable. It is editorial policy that usage of taxonomic nomenclature will comply with the mandatory provisions of the International Code for Zoological Nomenclature. Publication costs to authors will be free for the first ten pages and AUD$10 per page for additional pages. This covers unlimited use of colour which is encouraged. Authors receive a pdf copy of their paper and 10 hardcopy reprints sent by mail to the senior author.

Upon acceptance authors will be required to sign a copyright release enabling distribution of their paper electronically by our electronic distributer, Informit, in Melbourne. Authors retain the right to distribute their own papers in any way they wish. Further information for authors is given on the ESQ website at: https://www.esq.org.au/pdf/guide%20to%20authors2018.pdf

AVAILABILITY OF HARDCOPY BACK ISSUES

Most hardcopy back issues are available at discount rates as runs or as individual copies. Postage will be added to orders. Please contact the Business Manager at the email or address given above for an information sheet.

AVAILABILITY OF PDFs OF INDIVIDUAL PAPERS

Titles and abstracts of all papers published in *Australian Entomologist* since its inception in 1972 can be browsed, and full pdfs purchased at very reasonable rates, from the website of Informit at https://search.informit.com.au/browseJournalTitle;res=IELHSS;issn=1320-6133.

Printed by Bayfield Printing, Unit 6/60 Kremzow Rd, Brendale, Q 4500, Ph: 1300 685 820